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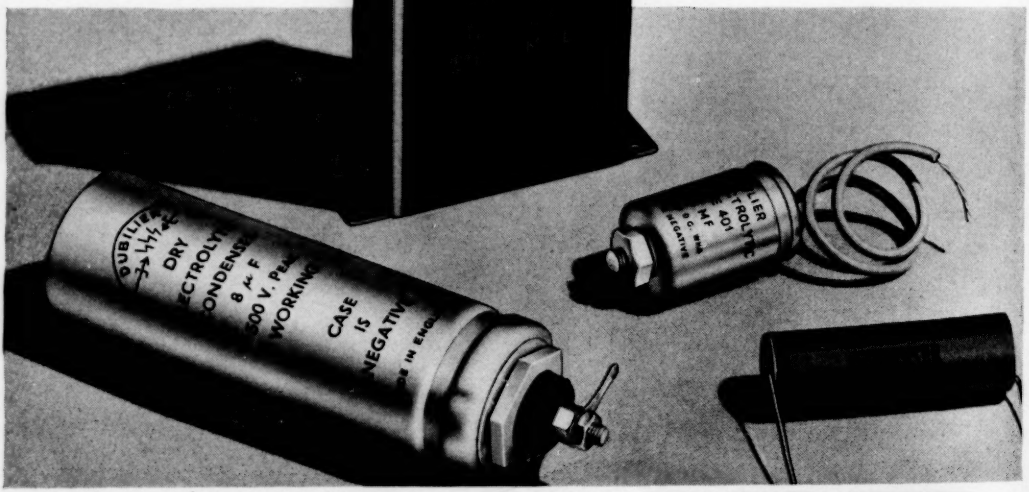

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AND

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VOL. XI. JUNE, 1934. No. 129

Editorial

Recent Developments in Insulating Materials

IT would hardly be an exaggeration to say that the developments which have taken place during the last three or four years in the manufacture of insulating materials are revolutionary. Quartz no longer holds the unique position which it did as the only insulating material to be considered suitable for use in the design of the highest quality of air-condenser. Synthetic insulation can now be made with equally good dielectric properties and with the added advantage that it can be moulded into a variety of forms. These new ceramic materials consist mainly of magnesium silicate derived from steatite or soapstone and talc. They can be made to have a wide range of properties suitable for various applications. The material which equals quartz in its freedom from dielectric loss has been named "Ultra-calan" by the Hermsdorf Company, in whose laboratories it has been developed. This material, which is very rich in magnesia and which is specially suitable for ultra-short-wave work, is somewhat limited in the forms in which it can be produced. The table gives the tangent of the loss angle, which is practically equal to the power-factor, for a number of materials at wavelengths between 100 and 3 metres. The dielectric constant is given in the last column.*

Material.	$10^4 \times \tan \delta$				κ
$\lambda =$	100 m.	30 m.	6 m.	3 m.	
Quartz ..	1.0	1.0	1.1	1.1	4.7
Ultra-calan .	1.0	1.0	1.1	1.1	7.1
Mica.. ..	1.7	1.7	1.7	—	7.0
Quartz-glass	1.8	1.7	1.7	—	4.2
Calan ..	2.8	2.6	2.5	1.8	6.6
Frequenta ..	3.0	2.8	2.6	—	6.1
Calit.. ..	3.7	3.4	3.2	—	6.5
Frequentit ..	8.0	6.8	6.0	—	6.0
Mycalex ..	18.0	18.0	18.0	—	8.0

Frequenta and Frequentit are made by the Steatit-Magnesia Co., whereas Calan and Calit are made by the Hermsdorf Co.

Although most of these ceramic materials have somewhat greater losses than mica, they are greatly superior in their mechanical properties. Not only can they be moulded to shape, but they are unaffected by the weather, even in the tropics. Ultra-calan

* From an article by Handrek in *Hochf. und Elektroakus*, March, 1934, p. 73.

A book entitled "Keramische Baustoffe für die Hochfrequenztechnik" by Schwandt was reviewed in *The Wireless World* of 5th Jan., p. 10.

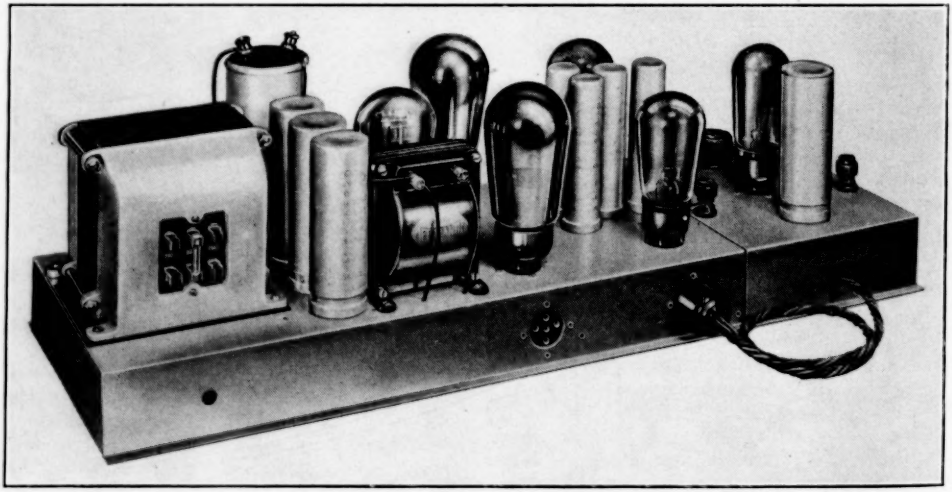
has a specific weight of 2.7, a crushing strength of 8,000 kg/cm², and a bending strength of 1,600 kg/cm². When used in precision air-condensers its temperature coefficient of linear expansion is an important factor; the value of this is given as 8.6×10^{-6}.

Another direction in which quite amazing developments have taken place is the manufacture of dielectric materials of very high dielectric constant. These are also ceramic materials which are said to contain titanium oxide as a base. Two such materials are known as Condensa and Kerafar. Of the materials enumerated in the above table, it will be seen that Mycalex has the highest dielectric constant, viz. 8, and this value is also reached by some types of glass, but these new materials can be made with any desired value between 20 and 100, without the value of tan δ exceeding 40×10^{-4}. The loss angle tends to increase with the dielectric constant. Condensa has not such good mechanical properties as those given above for Ultracalan, its crushing strength being only 3,000 kg/cm², but it can be turned, drilled, drawn, cast and pressed, and metal electrodes can be fused on to its surface. It can be made in the form of plates and tubes with a thickness down to 0.17 mm. Having a dielectric constant about ten times that of any material formerly employed, these new materials will enable certain types of condensers to be reduced to about a tenth of their present volume.

These achievements are not only valuable in themselves, but they hold out the promise of future developments in the production of dielectric materials with properties which until quite recently would have been considered impossible. G. W. O. H.

Straight Line Amplification

Double Push-Pull Equipment Described in "The Wireless World"



The Push-Pull Quality Amplifier is resistance-capacity coupled throughout. Two PX4 valves are used in the output stage to deliver a truly undistorted output of 4 watts, and they are fed by a pair of MHL4 valves. The input to this stage is obtained from a single triode, the requisite phase change being given by the use of both anode and cathode coupling resistances. The frequency characteristic of the complete apparatus, including output transformer, shows a loss of only 1.2 db. at 20 cycles and 2.95 db. at 10,000 cycles; the amplifier characteristic alone drops by 1 db. at 10,000 cycles.

The Degree of Amplitude Modulation*

Some Notes on Practical Measurement

By L. F. Gaudernack

(Natuurkundig Laboratorium der N. V. Philips, Gloeilampenfabrieken)

SUMMARY.—Some questions met with when measuring the degree of amplitude-modulation are discussed. The degree of modulation is defined as the ratio between amplitude-quantities, a clear distinction being made between what are defined as "up" and "down" values. The difference between unmodulated carrier-amplitude and "mean amplitude during modulation" is stressed. It is shown that for an arbitrary amplitude-modulation the effective value of the modulated current is dependent only on the amplitudes of the harmonics, whereas the degree of modulation depends largely on the phases as well. From this it follows that any "effective" method of modulation-degree measurement must be rejected as being not in accordance with the definition of the quantity to be measured. The effects of non-linearity in a *B*-amplifier and of over-modulation in a *C*-amplifier are discussed as regards the rise of "mean H.F.-ampl.," the formation of harmonics, and the resulting degrees of modulation. After a short critical review of some existing methods, general requirements are proposed for a measuring device, and a description of the principle and performance of a direct reading modulation-meter is given.

A "ripple-meter" constructed to measure exceedingly small degrees of modulation, and developed according to similar lines as the modulation-meter, is also shortly described as to principle and capabilities.

I. Introduction

ONE may perhaps use the term "modulation of fundamental form" or shortly "fundamental modulation" for the now almost classical case of a pure sine wave of high-frequency being modulated in amplitude by a low-frequency source, also of pure sine wave form. For this fundamental form of modulation the physical interpretation is relatively simple, the usual method being the well-known one involving the two side-frequencies associated with the modulation (1).

The practical form of modulation is, however, rather more complex, first, because the actual low-frequency source commonly has a broad frequency spectrum, and secondly, due to non-linearities some distortion is always introduced in the low-frequency part of the installation and in the high-frequency part as well.

Distortion in the low-frequency equipment is generally due to non-linearities of dynamic characteristics; in the worst case due to overloading or faulty settings of valves and is most pronounced at the extremities of the low-frequency spectrum where load-impedances may have unsatisfactory values.

Distortion in the high-frequency part is commonly caused by non-linearities in the dynamic characteristics of the modulated *C*-amplifier and the succeeding *B*-amplifiers. The resulting distortion-factor is generally found to increase rapidly with the degree of modulation.

By a "Class *C*" amplifier is here meant a high-frequency power-amplifier which is so adjusted that the output power is proportional to the square of the applied D.C. anode-voltage. In general, a "*C*" amplifier would be given such values of grid-voltages and anode-load-impedance as to secure a high anode-efficiency. By a "Class *B*" amplifier is meant a high-frequency amplifier which is so adjusted that the output power is proportional to the square of the high-frequency input-voltage applied to the grid. Such an amplifier would be given grid-voltages and anode-load-impedance of such values as to secure about 30 per cent. anode-efficiency in the unmodulated state of conditions.

A "*C*" amplifier is suitable for linear anode-modulation, the anode-efficiency being as a rule, independent of the D.C. anode-voltage.

A "Class *B*" amplifier is suitable for linear amplification of modulated high-frequency currents, and has an anode-efficiency which is proportional to the input high-frequency voltage applied to the grid.

It is the main intention of this paper to

* MS. accepted by the Editor, November, 1933.

discuss some typical forms of distortion frequently met with in practice, specially with regard to their influence on the degree of modulation and the effective value of the modulated high-frequency current. From this discussion some information may be had as to the specification for a device for the measurement of the degree of amplitude-modulation.

II. Definition of Percentage of Modulation

For the discussion of methods of measurement of any quantity, it seems desirable to start with a definition of the quantity we want to measure.

We are considering a high-frequency current of cyclic frequency ω and of amplitude A :

$$i = A \sin \omega t \qquad .. \quad (1)$$

Here we assume the amplitude A to be some arbitrary but periodic function of time, let the period of this function A be T. By the magnitude

$$A_0 = \frac{1}{T}\int_0^T A\,dt \qquad .. \qquad .. \quad (2)$$

we define the mean value of the high-frequency amplitude *during modulation*. This distinction is of some importance, as A_0 is not necessarily equal to the amplitude of the carrier-current when not modulating. As will be shown later, this case is caused by non-linearities in B-amplifiers for high-frequency.

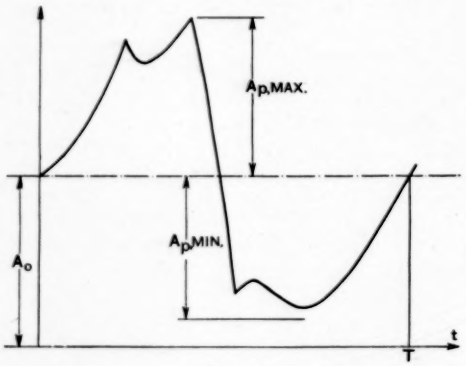


Fig. 1.

Further on we write

$$A = A_0 + A_p(t) \qquad .. \quad (3)$$

where $A_p(t)$ represents some function with its mean value equal to zero. Let further $A_{p\,\max.}$ be the maximum value and $A_{p\,\min.}$ the minimum value of $A_p(t)$ in the period T (see Fig. 1). Now mathematically $A_{p\,\min.}$ may have any negative value, physically however, no transmitter can give less than zero amplitude, therefore we put $A_{p\,\min.}$ under the following restriction

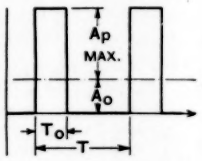


Fig. 2.

$$|A_{p,\,\min.}| \leqq A_0 \;..\; (4)$$

We then define " the percentage of modulation " in the following way

(1) The percentage of " positive modulation " or shorter, " per cent. *up*-modulation " we define by

$$m_u = \frac{A_{p\,\max.}}{A_0} \cdot 100\ \% \qquad .. \quad (5)$$

(2) The percentage of " negative modulation " or " per cent. *down*-modulation " we define by*

$$m_d = \frac{|A_{p,\,\min.}|}{A_0} \cdot 100\ \% \qquad .. \quad (6)$$

With the above-mentioned restriction (4) for $A_{p\,\min.}$ m_d cannot become greater than 100 per cent., however, this is not essential for the up-modulation m_u. We have an example of this case when considering a telegraph transmitter which is giving " sharp " dots, illustrated in Fig. 2. If we here assume rectangular curves and call T_0 the duration of one dot, we have

$$\left.\begin{aligned} & A_0 \cdot T = T_0(A_0 + A_{p\,\max.}) \\ \text{or} \quad & m_u = \frac{A_{p\,\max.}}{A_0} = \frac{T - T_0}{T_0} \cdot 100\ \% \\ & m_d = \frac{|A_{p\,\min.}|}{A_0} = 100\ \% \end{aligned}\right\} \;..(7)$$

Thus $m_u \gtreqless 100\ \%$ if $T_0 \lesseqgtr \frac{T}{2}$.

If $m_u = m_d \qquad .. \quad .. \quad .. \quad (8)$

we say that the modulation is *symmetric*, but this does not exclude low-frequency harmonics. From a measurement showing the presence of symmetric modulation one

* The terms " positive- " and " negative peak modulation " have also been used.

cannot conclude that the envelope is free from harmonics. It is, however, easily seen that the pure fundamental form of modulation is symmetrical.

Realising that amplitude-modulation means variation of amplitude, and that the peak amplitude for tolerable distortion limits the range of variation, it seems to be natural that any definition of per cent. modulation must be based on relations between *peak*-quantities.

III. The Effective (R.M.S.) Value of an Arbitrary Amplitude-modulated Current

Since the introduction of modulation into practice well-known formulas have been established for the effective value of an amplitude-modulated current, specially is the " fundamental form " of modulation well known in this respect. There are, however, some questions concerning the range of validity of these formulas which seems to be rather interesting from a physical point of view.

Taking the fundamental form, the following question may be raised: Is the validity of the formula unaffected by the ratio between the frequencies of high-frequency and the low-frequency current $\left(\frac{\omega}{p}\right)$?

This seems to be of some importance in connection with badly distorted modulation where some harmonic of the modulation frequency may become of the same order as the high-frequency. Another question is of interest: Is there some simple relation between degree of modulation and effective value of the modulated current when we are over-modulating a transmitter ?

The following popular and unexact reasoning may be used to arrive quickly at the formula for effective value of a modulated current:

Let us consider some arbitrary modulated current

$$i = A \sin \omega t \quad .. \quad .. \quad (9)$$

A having the period T. The effective (R.M.S.) value J of the current i is then defined by

$$J^2T = \int_0^T A^2 \sin^2 \omega t \, dt \quad .. \quad (10)$$

where we assume it to be right to integrate over one L.F. cycle (10) becomes

$$J^2T = \tfrac{1}{2}\int_0^T A^2 \, dt - \tfrac{1}{2}\int_0^T A^2 \cos 2\omega t \, dt$$

making now the rough assumption that A^2 is sensibly constant over the time $\frac{\pi}{\omega}$ which is the period of $\cos 2\omega t$ the last integral vanishes and we find

$$J^2 = \frac{1}{2T}\int_0^T A^2 \, dt \quad .. \quad (11)$$

which means that the effective value of the modulated current is equal to $\frac{1}{\sqrt{2}}$ times the effective value of the envelope-curve of the amplitudes.

Examples.

I. $$A = A_0(1 + m \sin pt) \quad .. \quad (12)$$

Here A is composed of a D.C. current of effective value A_0 and an alternating current of effective value $\frac{A_0 m}{\sqrt{2}}$ the effective value of this compound current being

$$\sqrt{{A_0}^2 + \left(\frac{A_0 m}{\sqrt{2}}\right)^2}$$

Thus we find

$$J = \frac{A_0}{\sqrt{2}}\sqrt{1 + \frac{m^2}{2}} \quad .. \quad (13)$$

$\frac{A_0}{\sqrt{2}}$ is here the effective value of the mean amplitude during modulation (carrier).

II. $$A = A_0(1 + m_1 \sin . pt + m_2 \sin 2pt) \quad (14)$$

The effective value of this envelope is equal to

$$\sqrt{{A_0}^2 + \left(\frac{A_0 m_1}{\sqrt{2}}\right)^2 + \left(\frac{A_0 m_2}{\sqrt{2}}\right)^2}$$

Thus we find for the effective (R.M.S.) current

$$J = \frac{A_0}{\sqrt{2}}\sqrt{1 + \frac{{m_1}^2 + {m_2}^2}{2}} \quad .. \quad (15)$$

It is easily seen that the modulation given by (14) is symmetric.

III. The following amplitude-function

$$A = A_0(1 + m_1 \sin pt + m_2 \cos 2pt) \quad (16)$$

gives the same effective current (15) as is easily verified, but here the modulation is unsymmetric, the " up " value being

$$m_1 - m_2 = m_u$$

and the " down " value

$$m_1 + m_2 = m_d$$

Thus, changing the phase of the second harmonic 90 deg. changes the modulation from symmetric to unsymmetric, the effective current being the same.

IV. Assuming A to have the general form

$$A = A_0\{1 + \Sigma m_n \sin (npt + \phi_n)\} \quad .. \quad (17)$$

and applying the formula (11) one finds the general expression for the effective current

$$J = \frac{A_0}{\sqrt{2}} \cdot \sqrt{1 + \tfrac{1}{2}\Sigma(m_n)^2} \quad .. \quad (18)$$

The modulation given by (17) is an arbitrary one, it is interesting to note that no restriction whatever is put on the values of the fractions m_n. The two degrees of modulation resulting from (17) is determined by the values of m_n and of the phase-angles ϕ_n. Let us now turn to the question of the influence of the ratio $\frac{\omega}{p}$ by considering in some detail the fundamental case of modulation.

$$i = A_0(1 + m \sin pt) \sin \omega t$$

$$= A_0 \sin \omega t + \frac{mA_0}{2} \cos (\omega - p)t - \frac{mA_0}{2} \cos (\omega + p)t \quad (19)$$

By taking the second power of the last expressing one finds after reducing

$$i^2 = A_0^2\Big\{\tfrac{1}{2} + \frac{m^2}{4} + \frac{m^2}{8}\cos 2(\omega - p)t + \frac{m^2}{8}\cos 2(\omega + p)t + \frac{m}{2}\sin (2\omega - p)t - \frac{m}{2}\sin (2\omega + p)t + m \sin pt - \frac{m^2}{4}\cos 2pt - \tfrac{1}{2}\Big(1 + \frac{m^2}{2}\Big)\cos 2\omega t\Big\} \quad .. \quad .. \quad (20)$$

Thus the energy consists of a constant term plus a sum of trigonometrical functions of cyclic frequencies

$$\begin{array}{l} 2\omega - 2p \\ 2\omega - p \\ 2\omega \\ 2\omega + p \\ 2\omega + 2p \\ p \\ 2p \end{array} \quad .. \quad .. \quad (21)$$

By integrating (20) one finds the classical formula (13). Putting in (20) $p = \omega$ an interesting case arises, the lower sideband gets then the frequency zero and the effective value becomes

$$J = \frac{A_0}{\sqrt{2}}\sqrt{1 + \frac{3m^2}{4}} \quad .. \quad .. \quad (22)$$

This is also easily seen by substituting for p directly in (19)

$$i = A_0 \sin \omega t + mA_0 \sin^2 \omega t$$

$$= A_0 \sin \omega t - \frac{mA_0}{2}\cos 2\omega t + \frac{mA_0}{2} \quad (23)$$

The effective value of this composite current is

$$J = \sqrt{\Big(\frac{A_0}{\sqrt{2}}\Big)^2 + \Big(\frac{mA_0}{2\sqrt{2}}\Big)^2 + \Big(\frac{mA_0}{2}\Big)^2}$$

$$J = \frac{A_0}{\sqrt{2}}\sqrt{1 + \frac{m^2}{4} + \frac{m^2}{2}}$$

in accordance with (22).

This case could presumably be realised by a tetrode by modulating in the screen-grid circuit. We return now to the general modulation form given by the amplitude function (17) and start to consider the effective value from the sideband-method point of view.

We have

$$i = A_0\{1 + \Sigma m_n \sin (npt + \phi_n)\} \sin \omega t \quad (24)$$

By introducing the side frequencies in the conventional manner and taking the second power of i one finally finds

$$\begin{aligned} \frac{i^2}{A_0^2} &= \tfrac{1}{2} + \tfrac{1}{4}\Sigma m_n^2 \\ &+ \tfrac{1}{8}\Sigma m_n^2 \cos\{(2\omega - 2np)t - 2\phi_n\} \\ &+ \tfrac{1}{2}\Sigma m_n \sin\{(2\omega - np)t - \phi_n\} \\ &- \tfrac{1}{2}\cos 2\omega t \\ &- \tfrac{1}{2}\Sigma m_n \sin\{(2\omega + np)t + \phi_n\} \\ &+ \tfrac{1}{8}\Sigma m_n^2 \cos\{(2\omega + 2np)t + 2\phi_n\} \\ &- \tfrac{1}{4}\Sigma\Sigma m_n m_k \cos\{(2\omega + [k - n]p)t + \phi_k - \phi_n\} \\ &+ \Sigma m_n \sin (npt + \phi_n) \\ &- \tfrac{1}{4}\Sigma\Sigma m_n m_k \cos\{(n + k)pt + \phi_n + \phi_k\} \quad .. \quad (25) \end{aligned}$$

where n and k mean whole positive numbers from 1 to the highest order of harmonic present.

We find here also i^2 composed of a constant term

$$\frac{{A_0}^2}{2}\left(1 + \tfrac{1}{2}\Sigma {m_n}^2\right)$$

which constitutes the square of the effective value found approximately in formula (18), plus a sum of trigonometric functions with the frequencies

$$\begin{array}{lll} (a)\ l \,.\, p & \text{where } l = n \text{ and } n + k \\ (b)\ 2\omega - lp & ,, \quad l = n \text{ and } 2n \\ (c)\ 2\omega & \\ (d)\ 2\omega + lp & ,, \quad l = n,\ 2n \text{ and } k - n \end{array} \qquad \ldots \quad \ldots \quad (26)$$

Assuming that none of these frequencies equals zero, the formula (18) for the effective value is correct.

Of the four frequencies in (26) only (b) and (d) can have zero values (b) for

$$n' = \frac{\omega}{p} \text{ and } n'' = \frac{2\omega}{p} = 2n' \qquad \ldots \quad (27)$$

which means that ω must be a harmonic of p.

The frequencies (d) have zero values for the combinations of n and k which satisfy the relation

$$n - k = \frac{2\omega}{p} \qquad \ldots \quad \ldots \quad (28)$$

To take a concrete example, assume that $\frac{\omega}{p} = 10$, then the following correction term is found from (25):

$$\Delta = \tfrac{1}{8}\, {m_{10}}^2 \cos 2\phi_{10} - \tfrac{1}{2}\, m_{20} \sin \phi_{20} - \tfrac{1}{4}\, \Sigma m_{20+k}\, m_k \cos\left(\phi k - \phi_{20+k}\right)$$

Of course, the fractions of so high an order as 10 are in general small quantities, so that the correction term Δ generally will be of no importance. Concluding it may be stated that for the most general form of amplitude modulation there is no direct and simple relation between the two depths of modulation and the effective (R.M.S.) value of the modulated H.F. current. In general, the latter is only dependent on the fractions m_n, while the former depend largely on the phase-angles ϕ_n as well.

IV. Effects of Non-linearity in a "Class B" H.F. Amplifier

We are considering the fundamental form of modulation

$$A_1 = A_0\,(1 + m \sin pt) \qquad \ldots \quad (29)$$

the effective value of the modulated current being

$$J = \frac{A_0}{\sqrt{2}} \sqrt{1 + \frac{m^2}{2}} \,. \,. \qquad \ldots \quad (30)$$

We assume further this type of modulation to be applied to the grid of a "Class B" H.F. amplifier having the following transfer characteristic (excitation-curve).

$$A' = \alpha A_1 + \beta {A_1}^2 \qquad \ldots \quad (31)$$

where A' = Anode current amplitude.

This means that anode-circuit quantities are not strictly proportional to the grid-circuit quantities, a second power term is assumed to form the non-linearity.

Putting $m = 0$ we find the *unmodulated* carrier-amplitude in the anode circuit equal to

$$A_c' = \alpha A_0 (1 + \gamma) \qquad \ldots \quad (32)$$

where the abbreviation

$$\gamma = \frac{\beta}{\alpha} \,.\, A_0 \qquad \ldots \quad \ldots \quad (33)$$

is introduced.

By substituting A_1 from (29) in the transfer equation (31) one finds

$$A' = A'_0 (1 + m_1 \sin pt - m_2 \cos 2pt) \quad (34)$$

this representing the amplitude function which is present in the anode circuit.

Here A'_0 is the mean amplitude during modulation, m_1 the first and m_2 the second harmonic fraction. These quantities are related to the grid-quantities and the transfer constants by the following equations

$$\begin{aligned} A'_0 &= \alpha A_0 \left\{1 + \gamma\left(1 + \frac{m^2}{2}\right)\right\} \\ m_1 &= \frac{m(1 + 2\gamma)}{1 + \gamma\left(1 + \frac{m^2}{2}\right)} \\ m_2 &= \frac{m^2}{2} \cdot \frac{\gamma}{1 + \gamma\left(1 + \frac{m^2}{2}\right)} \end{aligned} \qquad \ldots \quad (35)$$

From this we see that the mean amplitude during modulation is not equal to the unmodulated carrier-amplitude, differing from

this by the quantity $\beta A_0^2 \frac{m^2}{2}$. As for common excitation curves β is positive, we get a certain rise in mean amplitude due to the modulation ; this rise increases with the input modulation m. From (32) and (35) it is seen that the ratio between the mean amplitude during modulation A'_0, and the unmodulated carrier amplitude A_c', is given by

$$\frac{A_0'}{A_c'} = 1 + \frac{m^2}{2} \cdot \frac{\gamma}{1+\gamma} \qquad .. \quad (36)$$

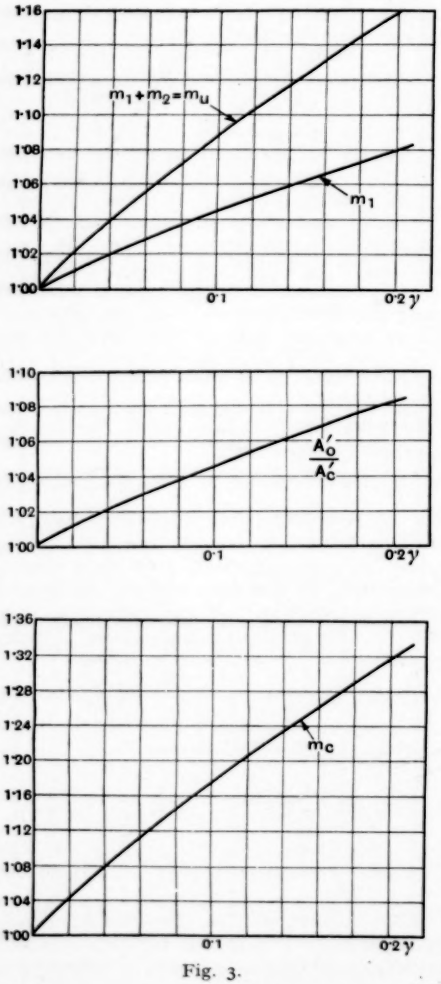


Fig. 3.

For $m = 1$, *i.e.*, 100 per cent. modulation in the grid circuit the rise in mean amplitude is computed as a function of γ, the result being plotted in Fig. 3 (middle curve). From what

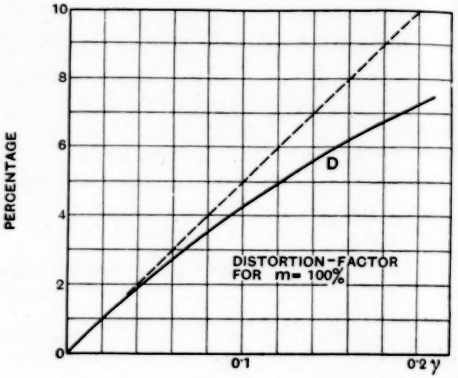


Fig. 4.

we have previously shown, the effective value of the modulated current is equal to

$$J = \frac{A'_0}{\sqrt{2}} \sqrt{1 + \tfrac{1}{2}(m_1^2 + m_2^2)}$$

$$= \frac{A_c'}{\sqrt{2}} \left(1 + \frac{m^2}{2} \frac{\gamma}{1+\gamma}\right) \sqrt{1 + \tfrac{1}{2}(m_1^2 + m_2^2)} \quad (37)$$

where m_1 and m_2 are to be substituted from (35). Assuming the non-linearity to be unknown, one would calculate a wrong degree of modulation m_c from the rise in effective value by putting

$$J = \frac{A_c'}{\sqrt{2}} \cdot \sqrt{1 + \frac{m_c^2}{2}} \qquad .. \quad (38)$$

From (37) and (38) m_c can be computed as a function of m and γ. For $m = 100$ per cent. m_c as a function of γ is shown as the lower curve of Fig. 3.

For $\beta < 0$ which means that the transfer characteristic is concave towards the abscissa-axis, γ is negative and the mean amplitude decreases when modulating. From (34) it is further seen that a second harmonic is introduced into the amplitude curve, causing distortion. The distortion factor defined as $D = \frac{1}{a_1} \sqrt{\Sigma a_n^2}$ where a_1 = amplitude of the fundamental and a_n = amplitude of the n^{th} harmonic, is for this case found

to be

$$D = m \cdot \frac{\gamma}{2 + 4\gamma} \quad .. \quad .. \quad (39)$$

and is thus directly proportional to m. For $m = 100$ per cent. D is shown as a function of γ in Fig. 4.

From this curve is to be seen that *ca.* 10 per cent. deviation from linearity is sufficient for 4 per cent. distortion. Further, it is seen that the modulation is changed from symmetric to unsymmetric, the " up " and " down " values in the anode circuit being respectively

$$m_u = m_1 + m_2 = m \cdot \frac{1 + 2\gamma + \gamma\frac{m}{2}}{1 + \gamma\left(1 + \frac{m^2}{2}\right)}$$

$$m_d = m_1 - m_2 = m \cdot \frac{1 + 2\gamma - \gamma\frac{m}{2}}{1 + \gamma\left(1 + \frac{m^2}{2}\right)} \quad .. \quad .. \quad (40)$$

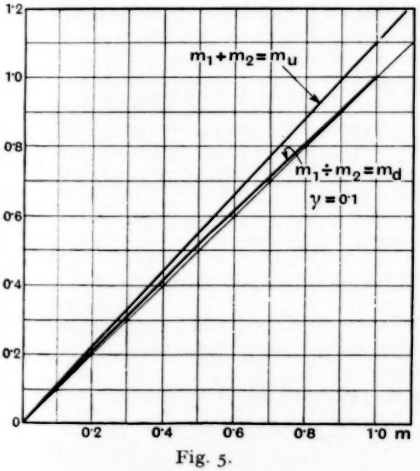


Fig. 5.

Here we note that for $m = 1$ in the input-circuit, $m_d = 1$ also in the anode circuit for all values of γ this, of course, being due to the fact that the assumptions involve that zero input gives zero output.

We further note that the methods of measurement which are based on the measurement of the two quantities

$$a = 1 + m_u$$
$$b = 1 - m_d$$

without measuring the true mean amplitude during modulation, and which propose the ratio

$$\frac{a - b}{a + b}$$

for the " degree of modulation " in reality measure the quantity

$$\frac{m_1}{1 + m_2}$$

which is less than the " up " value.

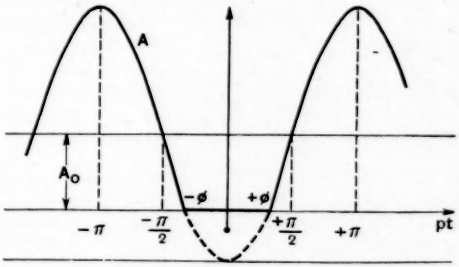


Fig. 6.

For $m = 100$ per cent. the " up " and " down " values together with the first harmonic fraction m_1 are shown as functions of γ as the upper curves of Fig. 3. m_d being constant $= 1$, 0. It is seen that m_c shown in the lower curves is considerably in excess of the real " up " value.

For negative values of γ, it is readily seen from formulas (40) that $m_1 < m$ and $m_2 < 0$. The " up " value is $m_1 + m_2 < m$ and the " down " value $m_1 - m_2 < m$, except for $m = 1$ when $m_1 - m_2 = 1$ also.

Finally, m_u and m_d have been computed as functions of m for $\gamma = 0$, 1, and are shown in Fig. 5.

Note the characteristic form of the m_d — curve.

V. Distortion Due to Overmodulation in a " Class C " Amplifier

We consider here a high-frequency amplifier of the " Class C " type as defined on page 293 and suppose this amplifier to be supplied with means for anode-modulation in one of the conventional forms. For 100 per cent. undistorted modulation the high-frequency output-current would be strictly proportional to the applied L.F. anode-voltage in the range from zero to twice the normal D.C. voltage.

We further make the assumption that this linearity also extends to values of the anode-voltage which are greater than twice the D.C. voltage, so that the high-frequency output-current linearly follows any up-modulation. Obviously this assumption involves an ample margin of saturation-current for the valve, as the range of linearity is limited by the definite value of the saturation-current. For a negative L.F. voltage at the anode we assume the high-frequency output current to be zero, this being well justified for well-neutralised amplifiers.

Let V_a be the D.C. anode-voltage, and mV_a the amplitude of the superimposed L.F. voltage of circular frequency p. For the momentary anode voltage we write

$$v_a = V_a(1 - m \cos X)$$

where $X = pt$. We are now going to investigate the abnormal state of modulation where $m > 1$, or what is normally called "over-modulation." As $m > 1$ the anode becomes negative, and the H.F. output zero, over a certain part of the L.F. cycle; but for the rest of the cycle the output current according to assumptions is proportional to v_a. So we get in the over-modulated state an amplitude function for the modulated high-frequency current as is illustrated in Fig. 6.

This amplitude-function is mathematically defined by the following relations

$$\left.\begin{aligned} A &= 0 \text{ for } && +\phi > X > -\phi \\ A &= A_0(1 - m \cos X) \text{ for } && -\phi > X > -\pi \\ \text{where } m &> 1 \text{ for } && +\pi > X > +\phi \end{aligned}\right\} \quad .. \quad .. \quad (41)$$

The "zero" angle ϕ is then defined by

$$\cos \phi = \frac{1}{m} \quad .. \quad .. \quad (42)$$

which also supposes $m > 1$ in order to give real values for ϕ. For the state of over-modulation we start mainly to discuss the following quantities as functions of the fraction m:

(1) Rise in mean H.F. amplitude due to the modulation.

(2) The real degree of "up" modulation.

(3) The content of harmonics and the distortion factor.

We develop the amplitude-function defined by relations (41) in a Fourier series

$$a(x) = a_0 + a_1 \cos x + a_2 \cos 2x + \ldots + a_n \cos nx + \ldots \quad .. \quad (43)$$

As the amplitude-function is of the symmetrical type, satisfying $A(x) = A(-x)$, all sine terms vanish. For the mean amplitude during modulation a_0, we find

$$\frac{a_0}{A_0} = 1 - \frac{\phi}{\pi} + \frac{tg\phi}{\pi} \quad .. \quad .. \quad (44)$$

This relative "rise" in mean amplitude is plotted as a function of m in Fig. 7 as the curve marked "a_0/A_0 rise." For $m = 2$, 0

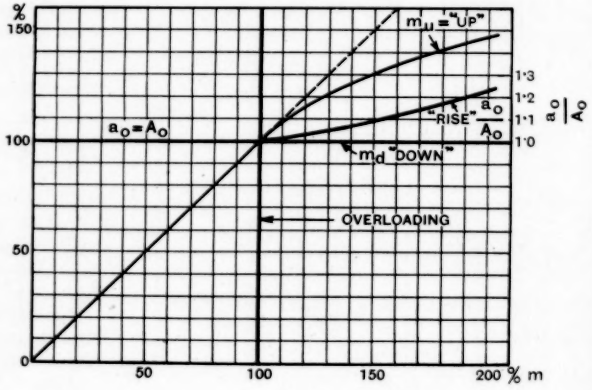


Fig. 7.

we find some 22 per cent. rise. The maximum value of the amplitude function A (41) is equal to $A_{max.} = A_0(1 + m)$. The "up" modulation is thus found to be

$$m_u = \frac{A_{max.} - a_0}{a_0} = \left[\frac{A_0}{a_0}(1 + m) - 1\right] \quad (45)$$

The "up" modulation is computed as function of m and the result is shown as the curve marked m_u of Fig. 7.

The "down" modulation m_d is, of course, 100 per cent., the minimum amplitude being zero.

From this we see that 100 per cent. over-modulation, *i.e.*, giving an anode peak voltage equal to twice the voltage which is necessary for 100 per cent. modulation,

results in :

22 per cent. rise in mean H.F. amplitude.

An " up " modulation of 146 per cent.

A " down " modulation of 100 per cent.

Due to a considerable increase in mean amplitude the " up " modulation is less than what would be expected from the supplied L.F. anode voltage.

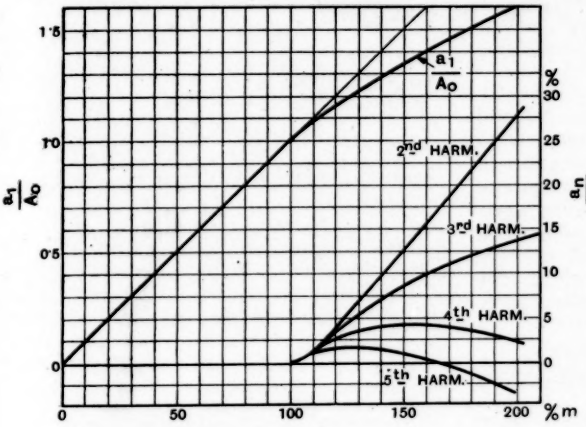


Fig. 8.

Returning to the individual harmonics, we find for the amplitude of the n^{th} harmonic

$$\frac{a_n}{A_0} = \frac{2}{\pi} \cdot \frac{1}{n^2 - 1}\left(\frac{\sin n\phi}{n} - tg\phi \cdot \cos n\phi\right) \quad .. \quad (46)$$

As this formula gives indefinite values for $n = 1$, the fundamental must be computed directly, which gives

$$-\frac{a_1}{A_0} = \frac{\sin \phi}{\pi} + \frac{1}{\cos \phi}\left(1 - \frac{\phi}{\pi}\right) \quad .. \quad (47)$$

For the following harmonics up to the 5th we find

$$\frac{a_2}{A_0} = \frac{2}{3\pi}\{tg\phi - \sin \phi \cos \phi\}$$

$$\frac{a_3}{A_0} = \frac{2}{3\pi} \cdot \sin^3\phi$$

$$\frac{a_4}{A_0} = \frac{2}{15\pi}\{5 - tg^2\phi\} \sin^3\phi \cos \phi$$

$$\frac{a_5}{A_0} = \frac{2}{\pi}\left(\frac{\cos^2\phi}{3} - \frac{\sin^2\phi}{5}\right) \sin^3\phi \quad .. \quad (48)$$

These harmonic amplitude ratios are plotted as functions of m in the curves of Fig. 8, where the trivial part for $m < 100$ per cent. also is shown for the sake of illustration. It should be noted that the harmonics are plotted in ratio to A_0 and not to the fundamental a_1; this last ratio is, however, easily found from the data supplied. From the curves of Fig. 8 the magnitude of interfering side-frequencies due to over-modulation may be found.

Finally, the distortion-factor defined by

$$D = \frac{1}{a_1} \cdot \sqrt{\Sigma a_n^2}$$

is computed neglecting harmonics above the fifth.

The result is shown in Fig. 9, from which it may be seen that if we assume 10 per cent. to be the limit for perceivable distortion, $m = 140$ per cent. modulation is allowable. However, interference in neighbouring channels may perhaps be the real limiting factor as regards over-modulation. For the effective (R.M.S.) value of the modulated current we find by applying formula (11)

$$J = \frac{A_0}{\sqrt{2}} \cdot \sqrt{\left(1 + \frac{1}{2\cos^2\phi}\right)\left(1 - \frac{\phi}{\pi}\right) + \frac{3}{2\pi} \cdot tg\phi} \quad .. \quad .. \quad (49)$$

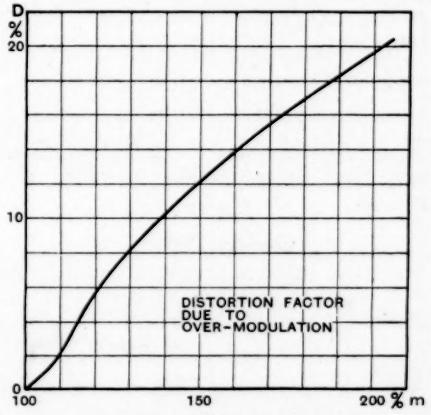


Fig. 9.

If we calculate the " degree of modulation " (m_e) from rise in R.M.S. value, we also in this case find values in excess of the real degrees of modulation.

(To be concluded.)

A Direct Reading Thermal Modulation Meter *

By F. R. W. Strafford

Introduction

A MODULATION meter is a useful laboratory acquisition, particularly to those engaged in an examination of detecting devices for broadcast reception. In general, such meters are dependent upon a thermionic valve or valves for their functioning, and are rarely direct reading, unless specifically incorporated within the generating source of modulated potential to be measured.

Calibration difficulties are generally encountered and the scale reading is usually extremely non-linear.

The following instrument, based upon well-known theory, has been designed to provide a portable meter with the following features, all of which should be necessary to facilitate accurate and rapid measurements :

(1) Direct reading.
(2) A high degree of calibration permanence.
(3) Reasonably linear full-scale readings.
(4) Stability.
(5) Portability.

A useful feature is the calibration process, which may be achieved by simple D.C. methods.

General Theory

Since the effective values of currents, due to a carrier both modulated and unmodulated, are well known, it is sufficient here to give only a brief analysis of the process.

The value of the instantaneous current for an unmodulated sinusoidal generator may be written as :

$$i_u = I \sin \omega t \quad .. \quad .. \quad 1.0$$

The r.m.s. value is :

$$\bar{I}_u = \sqrt{\frac{\omega}{2\pi}\int_0^{2\pi/\omega} i_u^2 \, . \, dt} = \frac{I}{\sqrt{2}} \quad .. \quad 1.1$$

Linear sinusoidal modulation of i_u will result in the equation :

$$i_m = I \sin \omega t[1 + M \sin \rho t] \quad .. \quad 1.2$$

The r.m.s. value now becomes :

$$\bar{I}_m = \frac{I}{\sqrt{2}}\left[1 + .5\, M^2\right]^{\frac{1}{2}}$$

$$\therefore \quad \bar{I}_m = I_u\left[1 + .5\, M^2\right]^{\frac{1}{2}} \quad .. \quad 1.3$$

If, therefore, an unmodulated carrier of the form given by 1.0 is applied to the heater of a thermocouple, the couple voltage will be proportional to I_u^2.

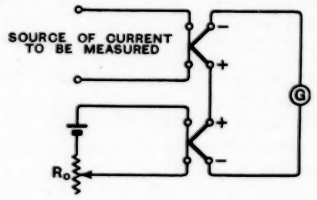


Fig. 1.

The effect of modulation is to increase the couple voltage by $[1 + .5\, M^2]$.

It can be seen that this represents a ratio increase of 1.5 for 100 per cent. modulation.

A modulation meter, thus constructed, would utilise only one-third of its full scale deflection for the complete modulation range.

Backing-off Method

If a backing-off potential is applied in the couple circuit to the voltage indicating device, the initial reading, due to the unmodulated carrier, may be balanced out and the indicating galvanometer may now be

* MS. accepted by the Editor, March, 1934.

increased in sensitivity so that a full scale deflection may be obtained over the complete modulation range.

A consideration of the problems shows

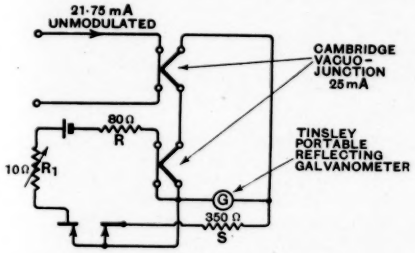


Fig. 2.

that, on account of the small potentials obtained from say, a 25 mA. heater thermo junction (6 millivolt is a normal figure) a resistance and battery introduced in the *couple* circuit to produce a backing-off voltage of similar but opposite magnitude necessitates an increase in the sensitivity of the indication galvanometer and subsequent danger of burn outs.

The method finally adopted is shown schematically in Fig. 1.

The thermocouples T_1 and T_2 are of identical characteristics and the couples are joined in series opposition. Signal current through the heater will produce no potential difference across the galvanometer terminals, so that the meter will only deflect when the current through one heater is changed in magnitude.

Practical Instrument

A practical arrangement of Fig. 1 is depicted in Fig. 2, where the circuit is rendered immune from overloads during preliminary adjustment, and is arranged for operation from an initial unmodulated line current of 21.75 mA.

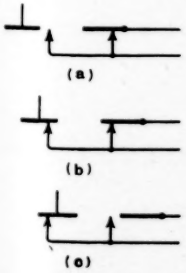


Fig. 3.

The switch is arranged to act in three positions, as shown in Fig. 3 (*a*), (*b*), (*c*). The operating procedure is as follows:

Switch Position (*a*).

The line current is increased until the shunted galvanometer reads about 75 per cent. full scale deflection. In the apparatus used in Fig. 3, this corresponded to an unmodulated line current of 21.75 mA.

The reading is arbitrarily employed as a test position on the galvo in the manner of usual practice, so that the unmodulated line current may be initially adjusted to its correct value, before modulation readings are taken.

Switch Position (*b*).

With the galvanometer still shunted, the backing-off current is switched on. With the fine adjustment resistance R_1 in mid position the resistance R is chosen so that a current corresponding to the value at which the test reading was selected flows through the heater. The galvanometer will now give a substantially zero deflection.

Switch Position (*c*).

This merely removes the shunt from the galvanometer, increasing its sensitivity to

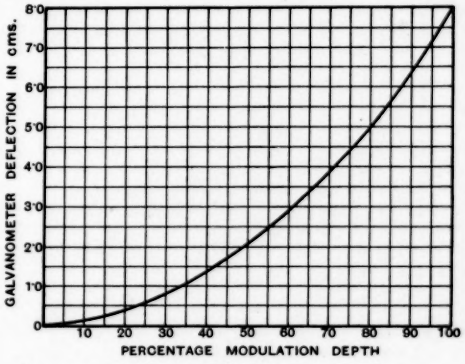


Fig. 4.

the desired value for full scale deflection over the complete modulation range.

Calibration is effected by direct current methods.

The value $[1 + .5\,M^2]^{\frac{1}{2}}$ is tabulated for $M = 0.1 - 1.0 = 10\,\% - 100\,\%$ modulation depth, and the incremental values of current so obtained are passed through the input heater *via* a standard milliameter.

These increments are plotted against the galvanometer deflection. Fig. 4 shows the calibration curve obtained in terms of the

apparatus and values employed in Fig. 2, whence it will be seen that the scale is reasonably open when the length (8 cms.) is considered.

For modulation depth of 10 per cent. upwards an accuracy of about 3 per cent. may be obtained, which is thought sufficiently accurate for all normal laboratory applications. Greater accuracy may be obtained by the use of more sensitive galvanometers with larger full scale deflections, but a limit is soon reached with normal thermocouples, and the zero becomes unstable and liable to drift.

The calibration may be independently checked by the normal cathode-ray method of producing a triangular pattern for 100 per cent. modulation. It is generally difficult, however, to measure the length of the lines produced to within close limits, and one would be more than justified in relying upon the original calibration by D.C. methods.

Book Review

Loud Speakers : Theory, Performance, Testing and Design

By N. W. McLachlan, D.Sc., M.I.E.E. Pp. 399 + xii. 165 Diagrams. Published by Oxford University Press, Warwick Square, London, E.C.4. Price, 40s.

Few people have given more attention to the problem of the realistic reproduction of sound than the author of this treatise. For a large percentage of listeners interest in wireless is centred in radio-frequency reception ; almost anything in the way of quality of reproduction, or lack of it, is tolerable. Such an attitude is fostered by the endless mutations in circuit design and the welter of new valves which the experimenter is offered. The average set is evidence of its appeal. To the smaller percentage to whom the receiving set is an apparatus, interesting maybe, whose primary function is to reproduce speech and music, the publication of this work is important. That good, though by no means perfect, reproduction is now possible is due in considerable measure to the work of the author in recent years. The present volume sets out in logical form his own and the work of other experimenters in this interesting field. It does more. The fundamental principles involved are critically examined and the directions in which advance may be made are indicated.

The book is divided naturally into two sections. The first is mainly analytical and is concerned with the relevant acoustic and mechanical principles. The mathematics in this section is not easy, but the author has succeeded in approaching the problems in a way which the engineer will appreciate. This attitude may be particularly exemplified by the treatment of the flat disc vibrating in a semi-infinite medium—the starting point of the diaphragm speaker. As a piece of mathematical theory Rayleigh's analysis is unimpeachable, yet it has no appeal to the engineer. It involves a complicated double integration from which the total force upon the disc emerges. The author's approach is essentially physical ; the force at a given point on the disc is determined and thence the total pressure. The mechanical problem is always in the foreground ; the analysis is incidental. The relevant acoustical principles are treated in the same manner. The fundamental principles of the propagation of sound in air are given clearly and are immediately applied to loud-speaker problems. The characteristics of driving mechanisms and diaphragms follow. The moving-coil loud speaker is treated exhaustively. The relations between the mechanical and electrical systems are deduced and their application to design is considered. Hitherto the theory of the electrostatic speaker has received little attention. It is here examined closely and the difficulties associated with the operation of this speaker are indicated. Nor has any completely satisfactory theory of the horn yet appeared ; the usual approximations cannot be accepted with equanimity. In many respects the author's treatment of the horn is novel and represents a definite approach to the facts.

The theory of sound as normally set out contemplates only infinitesimal amplitudes. In public address systems which may demand large amplitudes, modifications of the existing theory may be required ; this problem is examined.

The analytical (though not simply theoretical) work occupies roughly one-half of the book. The second half is devoted to the severely practical problems involved in reproduction. The mechanical systems employed in modern speakers are described and examined ; methods of measurement upon them are treated in detail. Particular questions dealt with are measurements upon magnets, both permanent and energised ; faults in magnet design and the troubles to which these faults give rise ; room effects in reproduction ; resonances ; properties of possible materials for diaphragm construction ; efficiency. The problem of adequate reproduction of the higher audible frequencies is examined from a practical point of view. Though possible it is not always desirable.

> "Gramophone reproduction is all scratch noise above 5,000 ~ . . . In broadcast programmes, induction, valve, and other noises, which are imperceptible in a system inadequate above 4,500 ~, would assume undue proportions if the range were extended to 12,000 ~ . . . So long as an insatiable appetite—not entirely of his own creation—exists for turning knobs to bring in a plethora of foreign stations, accompanied by the mutterings and mumblings of an over-wrought ether, the designer has no choice but to cut off everything above 5,000 ~."

The volume concludes with the practical design of speakers of large output. A very extensive list of references is appended.

This is the first comprehensive treatise on loud speakers published. It is a valuable addition to our scientific literature. The printing and general production are in accordance with the traditions of the Clarendon Press. A. G. W.

Inductance for Radio Frequencies*

A New Compact Standard

By W. H. F. Griffiths, F.Inst.P., A.M.I.E.E., Mem.I.R.E.

IN October, 1929, the author described in this journal[1] a new principle of inductance former construction which reduced the temperature coefficients of radio frequency inductance standards to almost negligible quantities. Moreover, the stability and long period permanence of coils wound on formers constructed on this principle were shown to be of a very high order due to the removal of all tendency for slackening or tightening of their windings with temperature change.

The principle, which is patented, is one of thermal compensation, effected by constructing a former from two insulating materials *A* and *B* having, among other qualities, *different* temperature coefficients of linear expansion. The material *A* determining the mean diameter of the coil is of a very strong and permanent nature and has a temperature coefficient of the same order as that of the conductor with which the coil is wound—so as to prevent slackening or tightening of the coil turns, with temperature changes.

The other material *B* is that on which the conductor is actually wound (usually in slots or grooves); it has a linear expansion coefficient just sufficiently greater than that of the *A* material so that the variation of inductance value due to the linear expansion of the former in an axial direction exactly compensates for the variation (of opposite sign) due to the area expansion of the turns caused by the thermal changes in material *A*, provided that the diametrical dimensions of the coil are not in any way influenced by the *B* material.

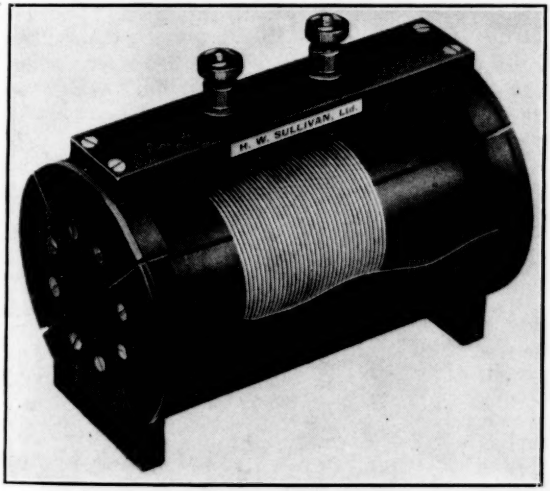


Fig. 1.—*Temperature compensated inductance standard of the single layer type.*

Coils of both single layer helix form and multilayer form have been successfully constructed and found to have temperature coefficients of only a few parts in a million per degree. They have proved *essential* in the construction of apparatus of the high degree of precision which present day research and measurement demand. Two examples of such apparatus are to be found in a 0.01 per cent. dynatron oscillating wavemeter[2] and an audio oscillator of the heterodyne type[3] having a stability of 1 cycle per second per day. Neither of these generators would have been possible but for the thermal compensated coils employed in the resonant circuits which determine their oscillation frequencies.

* MS. accepted by the Editor December, 1933.

[1] "Notes on Standard Inductances for Wavemeters and other Radio Frequency purposes," by the present author, Oct., 1929. *The Wireless Engineer.*

[2] "The simplification of accurate measurement of radio-frequency," by the present author *The Wireless Engineer*, May, 1933.

[3] "Precision Heterodyne Oscillators," by present author *The Wireless Engineer*, May, 1934.

Owing to its more robust construction the single layer type of coil as illustrated in Fig. 1 has hitherto been preferred as a really permanent standard in which the principles of the former construction are more exactly adhered to as will be seen upon reference to the previous article. But single layer helices of large inductance, if of low power factor (high magnification), must necessarily be of large dimensions. Moreover, if they are to be shielded without serious augmentation of power-loss, their screens must also assume very large proportions.

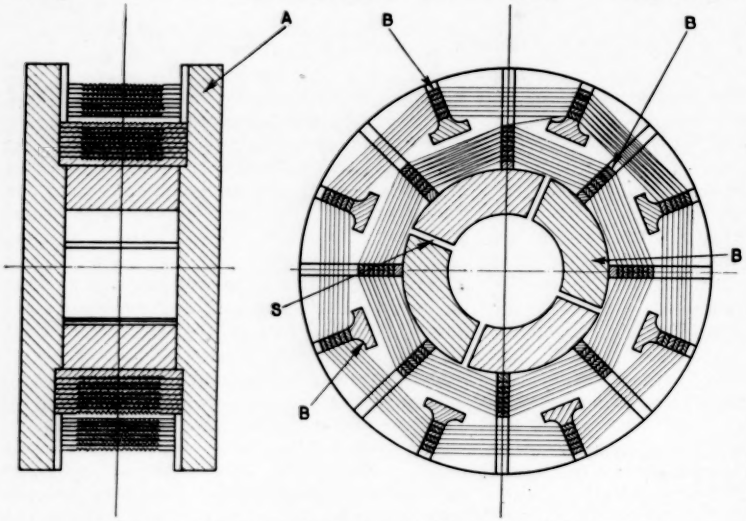


Fig. 2.—*Construction of a larger multilayer type of temperature compensated inductance standard.*

If, on the other hand, a more compact and more conveniently shielded multilayer design is resorted to, an indefinite degree of thermal compensation is often obtained, especially on coils of small diameter where the winding depth is comparable with the diameter. This is because the mean diameter of the coil is influenced by *B* material as well as by *A* material even when the coil is split up into two or more sections as shown in Fig. 2, which is reproduced from the original article.

The author has, however, recently designed a new type of compact multilayer coil in which the mean diameter is influenced only by *A* material while both the axial length and radial depth are governed by *B* material. The coil is illustrated in Fig. 3 and the principles of its construction are shown in Fig. 4.

The end cheeks of this coil, as in the larger coil of Fig. 2, are made from *A* material which therefore, since the segments of *B* material are circumferentially discontinuous, imparts to the coil a temperature coefficient twice that of linear expansion of the *A* material. The radial positions of the *B* material segments are determined by precise dowelling to the cheeks *on the radius of the mean turn*. The slotted strips or combs, in which the wire is wound, are also of

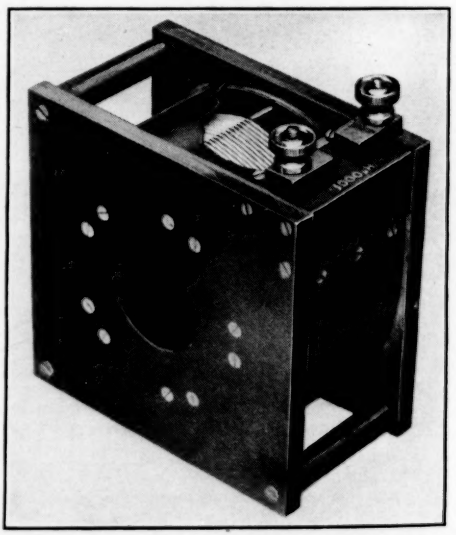


Fig. 3.—*The new small multilayer temperature compensated coil*

B material, the temperature coefficient of which is therefore effective only in governing the other two coil dimensions—the condition necessary for simple compensation. Coils up to 3,000 μH may be built to this design of dimensions such that complete shielding in cylindrical screens 20 cms in diameter and 12 cms long do not appreciably affect their magnification. If the workmanship is of the highest order the temperature coefficients of these coils are as low as 5 parts in a million per degree centigrade.

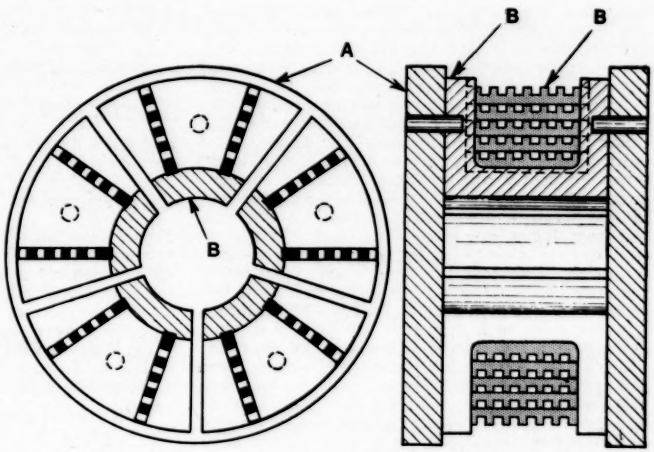


Fig. 4.—*The construction of the new multilayer temperature compensated inductance standard.*

The author feels that the importance of such coils, equally suitable for all frequencies and for all climates, cannot be over emphasied since, in the radio and telephone laboratory, the need for many precise measurements and laboratory instruments depending upon really permanent and stable inductances is rapidly increasing. Much laboratory apparatus available to-day cannot be relied upon for high calibration accuracy and stability because of the incorporation of inductances of ordinary design among their components.

Correspondence

Letters of technical interest are always welcome. In publishing such communications the Editors do not necessarily endorse any technical or general statements which they may contain.

Application of the Dynatron

To the Editor, The Wireless Engineer

SIR,—I am aware of Dr. Janusz Groszkowski's contributions to the subject of the frequency variation of oscillating systems, and greatly admire the way he has enabled us to form a clear conception of what has been the subject of gropings over many years. However, the apparent discrepancy noted by Mr. Scroggie (*W.E.*, Vol. X, p. 539, 10/33) was in no way concerned with the production of harmonics, his dynatron being operated in the threshold condition throughout the experiment. The explanation is as detailed in my letter published in your February issue.

As regards Prof. Mallett's experimental results, I was misled by a faulty memory. I intended to convey that it may be possible to explain the *divergence from the "LC value"* of the frequency of an oscillator having an inductance equal to L in series in its anode circuit, without recourse to the postulation of a non-linear R_a.

The use of automatic control circuits, as described by Dr. Groszkowski, results in the equations relating to the ideal conditions of the linear characteristic becoming of practical importance, and the frequency stability will then depend on the method of coupling the variable external load to the circuit, *i.e.*, magnetic coupling must have negligible leakage, and capacity coupling must offer a negligible series reactance.

Handsworth, Birmingham. G. FARREN CLARKE.

Beat Frequency Oscillator

To the Editor, The Wireless Engineer

SIR,—I found Mr. Lindsay's letter in the April issue, following on the article on "Beat Frequency Oscillators," published in September, 1933, of considerable interest. During the past few years a number of similar oscillators have passed through my hands and I can endorse Mr. Lindsay's remarks regarding the importance of condenser stability and have observed the extraordinary frequency stability obtained when air condensers are used instead of mica in the oscillating circuits. At the

time when this Company started manufacturing oscillators to the N.P.L. design, Mr. T. I. Jones expressed the view that the frequency drift found in some oscillators was largely due to the condensers. Subsequent experience has shown that this is so.

The probability is that two inductances will be extremely similar electrically and will have sensibly similar temperature coefficients and losses. In addition they usually have a relatively large thermal capacity and a large radiating surface. Provided that they are so disposed in the instrument that temperature changes due to causes other than their own losses are similar for both, frequency drifts due to change in inductance will balance each other. On the other hand a mica condenser, surrounded as it is by wax, forms a well insulated system with a low thermal capacity. The internal temperature of such a system will largely depend on the rate at which energy is dissipated inside it. In addition it is difficult to produce two condensers with precisely similar losses and temperature coefficients. However, by using mica condensers of negligible temperature coefficient and taking precautions to age them, quite good results have been obtained. The best oscillators now drift less than one cycle an hour.

WILLIAM C. LISTER.

Muirhead & Co., Ltd.,
Beckenham, Kent.

Precision Heterodyne Oscillators

To the Editor, The Wireless Engineer

SIR,—Mr. Griffiths' paper on "Precision Heterodyne Oscillators" has suggested to me various other methods of presenting the conditions of heterodyne stability, which may be of interest. A clear distinction will be drawn between (*a*) simultaneous variation of frequency of both oscillators, assumed perfectly matched, and (*b*) a frequency variation of one oscillator alone, the other remaining constant. A combination of these two effects will of course be necessary to represent the phenomena in any actual generator.

(*a*) Mr. Griffiths has shown in equation (1) of his paper (p. 235) that provided that the condition $L_1 = L_2$ and $C_1 = C_2$ is always satisfied,

$$F = k_1 \frac{\triangle C_2}{C_1^{3/2}} \quad .. \quad .. \quad .. \quad \text{(i)}$$

It follows that for a slight change in the value of the tuning capacities,

$$\frac{\delta F}{F} = -\frac{3}{2}\frac{\delta C_1}{C_1} \quad .. \quad .. \quad \text{(ii)}$$

A similar result will apply to the inductance values, so that for perfectly matched circuits the stability necessary in each is 50 per cent. greater than that required in the beat frequency.

For calibration constancy however the change in F is not so important as the possibility of restoring F to its correct value by a simple adjustment of $\triangle C_2$, such as is provided by the scale-setting condenser. Rearranging (i) in the form

$$\triangle C_2 = \frac{FC_1^{3/2}}{k_1}$$

and using dashes to indicate changed values of the variables,

$$\triangle C_2' - \triangle C_2 = \frac{F}{k_1}(C_1'^{3/2} - C_1^{3/2}) \quad .. \quad \text{(iii)}$$

Hence the necessary adjustment of the scale-setting condenser, $\triangle C_2' - \triangle C_2$, varies with F; on the other hand (ii) shows that with a linear condenser and a logarithmic scale a movement of the scale relative to the condenser would give correction over the whole frequency range.

(*b*) Suppose that L_1, C_1 (hence f_1) and C_2 remain constant, L_2 alone varying. Then we must alter the value of $\triangle C_2$ to $\triangle C_2'$ so that

$$L_2'(C_2 + \triangle C_2') = L_2(C_2 + \triangle C_2) = 1/4\pi^2 f_2^2.$$

We find that

$$\triangle C_2' - \triangle C_2 = (C_2 + \triangle C_2)\frac{\delta L_2}{L_2} \doteqdot C_2 \cdot \frac{\delta L_2}{L_2} \quad .. \quad \text{(iv)}$$

which can be corrected by the scale-setting condenser, since in practice $\triangle C_2$ is much smaller than C_2. The stability required with respect to differential changes between the two oscillators is easily found, for since $F = f_2 - f_1$,

$$\delta F = -\delta f_1 = -f_1\frac{\delta f_1}{f_1}$$

whence

$$\frac{\delta F}{F} = -\frac{f_1}{F}\frac{\delta f_1}{f_1} \quad .. \quad .. \quad .. \quad \text{(v)}$$

A similar argument applies to f_2, so that the unmatched instability of the radio-frequency oscillators must be f_1/F times less than the instability tolerable in the beat frequency. This is well known on physical grounds, since a frequency change of 1 c/s. in one of the oscillators produces a change of 1 c/s. in the beat frequency, but expressed as a *fractional* change the instability is f/F times worse in the beat frequency.

The frequency of the dynatron oscillator has already been fully discussed in these columns; it is sufficient to point out that whether or not one believes that the negative resistance of the valve can be regarded as an independent variable influencing the frequency, the square of the tuned circuit's decrement will be important, for this also occurs in the formulae of Moullin and Groszkowski for the effect of harmonics.

D. A. BELL.

Oxford.

Positive-Grid Valve as a Detector

The "Brake-Audion" or Retarding-Field Valve as a Detector, for Broadcast and other Frequencies

By H. E. Hollmann

Part II.

IF the valve is heated up gradually, the sensitivity curve takes the course shown in Fig. 7, with a pre-maximum at A followed by a null point at B, before a constant sensitivity is reached at C. The reason for this is that as the heating is increased the brake characteristic gradually raises itself from the abscissa axis, as shown in Fig. 8, and thus cuts the straight resistance characteristic (broken line) at different points. The pre-maximum A of Fig. 7 corresponds to the working point A of Fig. 8 in the upper bend of the brake characteristic III; at the null point the working point B lies on the linear part of curve II, and only when the emission is strong enough does the working point reach the bottom bend of the brake curve I.

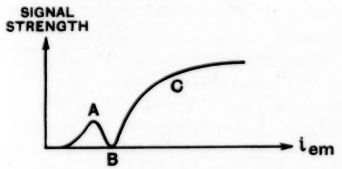


Fig. 7.—*Sensitivity curve for gradual increase of filament heating, showing pre-maximum.*

For small high-frequency potentials the automatic setting of the working point is not distinguishable from a fixed bias E_b. For potentials of a fraction of a volt upwards, however, the condenser C becomes negatively charged. This is best seen from the detection characteristic field of Fig. 9, through which the resistance straight line again passes. The detection curve field shows the brake characteristic $i_b = f(e_b)$ when two different high-frequency voltages e_1 and e_2 are superposed simultaneously on the brake voltage. In the lower-bend region the rectified currents $\triangle i_b$ are positive and the detection curves are displaced towards the negative; in the region of the upper bend the relations are reversed. Along the middle, straight part of the brake characteristic no rectification occurs, and the detection characteristics all coincide with the static brake

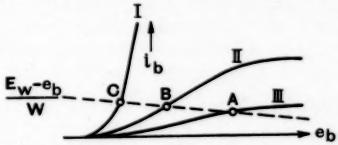


Fig. 8.—*Shifting of working point with falling internal resistance of brake field (three different emission currents).*

characteristic. Since at any moment the working point is fixed by the point of intersection of the detection curve for the particular high-frequency potential with the resistance straight line, it is seen that in the lower region (broken-line resistance straight line) a negative voltage E_c occurs, while in the upper region (dotted straight line) E_c is positive. If the high frequency is modulated, the potential E_c adjusts itself proportionally to the mean value, since C must be large enough for its charge fluctuations to be unable to follow the modulation.

This automatic displacement of the working point to the negative or positive side, or generally to the region of flat detection characteristic, has the result that the brake-

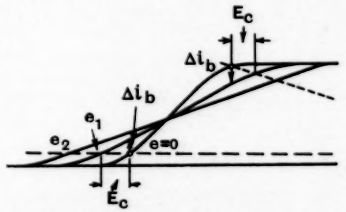


Fig. 9.—*Rectification characteristic field cut by the straight resistance characteristic.*

audion becomes less sensitive. This means that it no longer functions true to amplitude

with respect to the average value of the carrier voltage, but automatically gives a certain equalisation of amplitude. This result is shown in Fig. 10, where some resonance curves are plotted for a brake-audion, the abscissae representing the scale divisions of the input-circuit condenser. These curves only differ in their conditions in that curve *a* was taken with fixed brake potential and curves *b* and *c* with tapped-off leak potentials E_w (see Fig. 11) of 20 and 5 volts respectively. The automatic regulation is seen in the fact that with small high-frequency potentials outside the resonance zone all the curves run together, and as resonance is approached lag the more behind curve *a* the lower the leak potential. In comparison with the fixed working point the curve *c* shows a regulation with a ratio of 1 : 15.

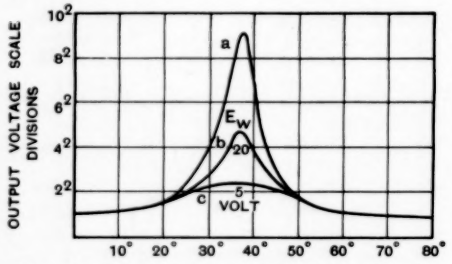


Fig. 10.—*Amplitude compensation with the brake-audion.*

For a practically useful fading compensation, however, much greater regulation ranges are required; this demand can now be easily fulfilled, by making use of the potential E_c at the condenser C to regulate the high-frequency pre-amplification, employing it as grid bias for the pre-amplifying stage. This method has the important advantage that as the condenser C must be very large, the regulating voltage E_c contains no a.c. components, and consequently no balancing circuits are required as is the case, for instance, in binode fading-compensating devices. Fig. 11 gives the diagram of a complete receiver with fading compensation with the brake-audion. Experiments have shown that with a single pre-amplifier valve a sufficient regulation range is obtained, since the brake-audion itself can take over whatever regulation is not fulfilled by the single stage.

An obvious development is to apply the regulating voltage supplied by the brake-audion to the control of its own character-

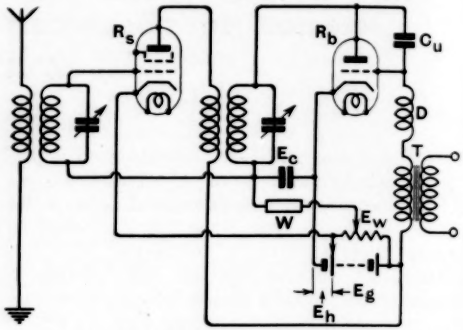


Fig. 11.—*Regulation of high-frequency pre-amplification by the brake-audion.*

istic instead of to the regulation of the pre-amplification, so as to increase very considerably the range of automatic control. The simplest way of doing this is by means of a regulating grid *RG* influencing the emission current (Fig. 12). Here an additional bias supply E_{rg} is provided for the correct adjustment of the working point, the remainder of the circuit being the same as previously described. The simple two-grid valve, however, introduces certain difficulties, in that the modulation voltages on the grid *G* penetrate the regulating grid *RG* and upset a constant current distribution. This defect can be avoided by introducing a screen grid *S* between *G* and *RG*, or better still by combining this with a further positively biased "suppressor" (or "collector") grid *SG*. In this way we obtain the arrangement

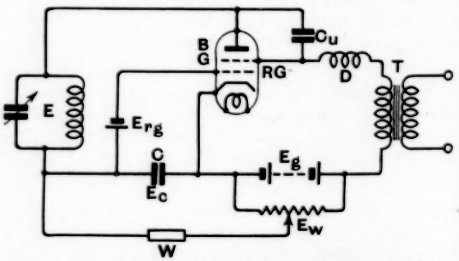


Fig. 12.—*Self-regulation of the brake-audion.*

of Fig. 13, in which the two valve systems R_1 and R_2, the former providing a controlled emission current for the brake-valve

system represented by the latter, are completely screened from one another.

The range of regulation of this self-regulating brake-audion is, it is true, limited in the upward direction, since on referring back to Fig. 8 it is seen that with too small emission currents the working point moves into the linear part of the brake characteristic II, where no reception is possible ; and it is quite immaterial whether the weakening of the emission current occurs as a result of decreased heating or of a negative regulating grid. The chain of processes leads to the result that the regulation range of the brake-audion can be completely over-controlled, whenever the high-frequency amplitudes or the regulating potential E_c become

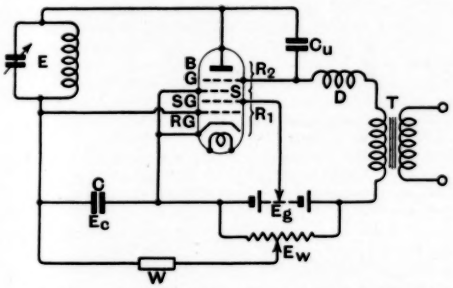


Fig. 13.—*Brake-audion with screen grid S and "suppressor" (or "collector") grid SG.*

so large that the brake characteristic is flattened down like curve III in Fig. 8 ; whenever, in fact, rectification takes place at the upper bend. In this event the brake-audion regulation is reversed ; *i.e.*, the sensitivity is increased. The curve of output volume, as a function of high-frequency carrier amplitude, may thus take the shape shown in Fig. 14, which somewhat resembles that of Fig. 7. This is particularly the case if the working conditions are badly adjusted. So long as the curve remains horizontal, the regulation occurs in the right sense, until over-control sets in. This shows itself first (compare curve II in Fig. 8) in a sensitivity minimum, but then produces a rapid rise in output volume as a result of the inverted regulation. In practice such over-control must, of course, be avoided by making the initial sensitivity as high as possible.

In the above, quite new methods of automatic fading regulation have been indicated, and it would seem that the existing methods of rectification in a special diode-system and low-frequency amplification in a special triode-system may well be replaced by the distinctly simpler brake-audion, particularly since it appears that an automatic regulation of its own sensitivity can only be obtained with the brake-audion.

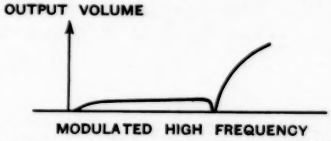


Fig. 14.—*Output volume at over-control.*

The Industry

THE distribution of T.M.C. Hydra condensers is to be undertaken by a new company, T.M.C.-Harwell Sales, Ltd., which will also act as a selling organisation for other products of the Telephone Manufacturing Co., Ltd.

Standard Telephones and Cables, Ltd., are now producing a complete range of universal A.C.-D.C. valves. All types consume 0.2 amp. at either 13 or 40 volts.

R. A. Rothermel, Ltd., have moved to Canterbury Road, High Road, Kilburn, London, N.W.6.

"Catkin" battery valves : The new "K" series of Marconi and Osram battery valves embody the "Catkin" method of sealing, but the envelopes are of glass. Electrical characteristics are similar to existing types, but the new valves are much smaller.

A special high-frequency varnish for impregnating H.F. windings has been developed by Mr. Paul D. Tyers. It is being manufactured by Grampian Reproducers, Ltd., Kew Gardens, Surrey.

Principles of Audio-frequency Wire Broadcasting

Paper by P. P. Eckersley, M.I.E.E., read before the Wireless Section, I.E.E., on 11th April, 1934.

Abstract

THE paper deals in general terms with all forms of wire broadcasting, but in particular with "Audio-frequency rediffusion." In carrier-frequency systems alternating currents of supersonic frequency are fed into a line network and modulated by the programme audio frequency. Such a system may use the electric light network as the vehicle of conveyance, but the subscriber's apparatus must embody a rectifier, as in an ordinary wireless receiver. In audio-frequency systems programmes originally transmitted by wireless are picked up by a receiver located where reception conditions are favourable, and the audio output of the receiver is applied to an amplifier which raises the level to a value sufficient to energise all the loud speakers connected to the conducting network.

It is usual for such systems to construct a new network for the purpose, either by buried cable or by overhead wires suspended from house chimneys or from poles. It is stated in the paper that the cost of a wire broadcasting system is much the same whatever the method used. Where existing networks can be utilised the consumer's apparatus is relatively complex, but where the consumer's apparatus is to be simply a loud speaker then new networks must be constructed.

The network is made up of a number of feeders which run out in different directions from the amplifier. Each feeder contains as many lines, *i.e.* pairs of wires, as there are programmes to be transmitted, "phantom" technique not having yet proved very successful. In British practice not more than two programmes are usually transmitted, so that one feeder contains two lines. In Holland, where wire broadcasting has been considerably developed, 3- or 4-programme services may be given. The currents in the two wires of each line are kept as far as possible in phase opposition so that cross-talk and interference with the telephone service may be avoided or minimised. The consumer is given his service via a branch feeder of lead-covered cable. Sometimes 10 to 15 subscribers are fed from one tee either by a "spray" of open wiring teed off for each subscriber or through extended lead wiring. Each householder has a switch to join the loud speaker to either programme or to open circuit, while some houses have lead-covered cable extensions to different rooms.

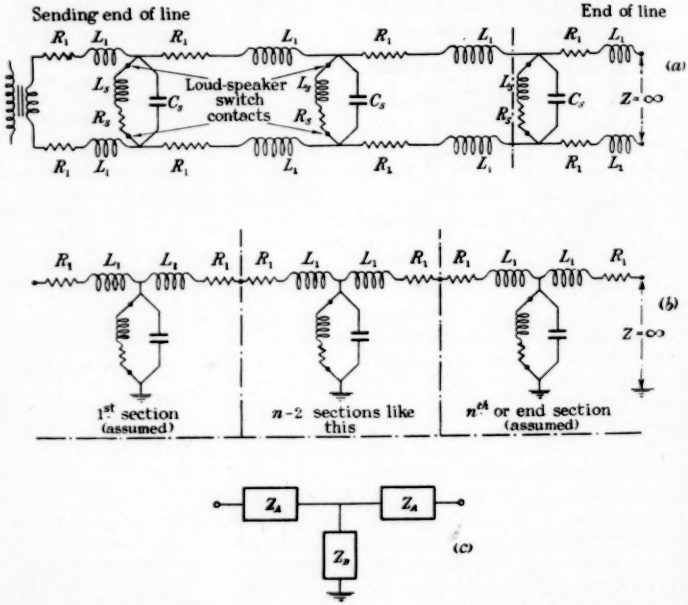


Fig. 2.—*Resolution of line into electrical equivalent.* (*a*) *Electrical equivalent of line, assuming only symmetry.* R_1 = *resistance of line between consumers.* L_1 = *inductance of line between consumers.* R_s = *resistance of loud speaker.* L_s = *inductance of loud speaker.* C_s = *capacitance of branch wiring.* (*b*) *Electrical equivalent of* (*a*)*, assuming that conditions will be undisturbed if* 1*st and* n*th sections are arranged as shown.* (*It is obviously fair to assume this.*) (*c*) *Representation of a section of the line.* $Z_A = 2(R_1 + j\omega L_1)$. Z_B = *impedance of* L_sR_s *and* C_s *as shown in* (*a*).

The equivalent circuit of the network is illustrated in Fig. 2,* and the paper discusses the frequency-characteristics of the system, particularly at

* The author's figure numbers are used.

the end of the feeder system. The analysis shows that one may plan long lines with few consumers or short lines with many consumers connected to them, but that the product n (consumers) $\times$ l (length) must always equal a constant to be determined. From considerations quoted in the paper it is shown that this product should not exceed 650, for l in kilometres.

The theoretical considerations show that the level on the outer parts of the network and the sending-end impedance should vary as shown in Fig. 4. The most pronounced variations from the sending level will be due to series resonance effects, when the level at the end of the lines may rise considerably above the sending-end level. It is apparent that these effects could be prevented or minimised if the lines were terminated by a resistance equal to the image impedance of a typical section. Various measurements in experimental verification of the theory are discussed and illustrated in the paper.

The transformer matching the amplifier valve output to the line has to give a sensibly constant output under all conditions of line loading. This introduces difficulties of design which lead the author to suggest that it is necessary to sacrifice some performance at low frequencies in order to obtain even a passable performance at high frequencies. Experiments suggest that a square type of core gives a lower leakage inductance than the more conventional core (*e.g.*, of the shell type), allowing a closer association between windings and core, and between winding and winding.

In connection with power requirements the author points out that the term "loud speaker power" is extremely ambiguous, and even when defined is not directly related to the power required to be delivered from a rediffusion amplifier. Experiments quoted in the paper have shown that the maximum peak voltage giving satisfactory volume in a typical living-room is of the order of the 100 volts at 200 c/sec. and of 70 volts at 50 c/sec It is therefore concluded that with a line of 25Ω at 50 c/sec. and 50Ω at 200 c/sec. the maximum r.m.s. volt-amperes required is about 100 per line, although 50 volt-amperes is a practical ideal.

The paper contains a specification drawn up by the author for a rediffusion amplifier system for a 4-feeder network and a 2-programme service, this including frequency discrimination, distortion limits, power supply, output transformer, monitoring arrangements, general construction, insulation resistance, valve replacement, etc. The section on output transformers also contains the Post Office regulations in relation to the distributing system.

In the concluding section of the paper the author states that the number of programmes available is limited if overhead networks are used. Overhead networks are not sightly, although they could be made less obtrusive if wayleaves were more readily granted. These networks supply an existing demand, but will disappear as newer and better methods of wire broadcasting are introduced. In order that the loss of bass reproduction at and near the ends of lines remote from the sending end shall be minimised, a series resistance of the order of 2,000 ohms should be connected in series with the loud speakers, which should preferably be of the moving-coil type. The amplifier power should be calculated for ideal conditions on a basis of 100 volt-amperes per line fed from the amplifier, but a reduction to 50 volt amperes is allowable. If buried cable is used with lower-resistance conductors than those used for overhead networks, power should be calculated on the basis of 400 millivolt-amperes per

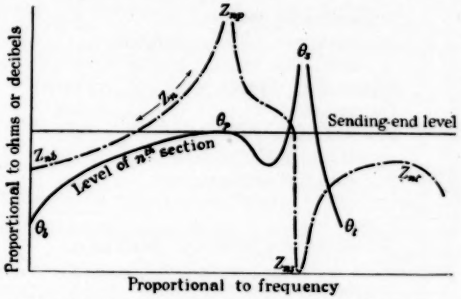


Fig. 4.—*Distribution of power in sending end impedance of a line as illustrated in Fig. 2.*

loud speaker. In practice amplifiers feed as many as four lines and must supply for a "practical" ideal 200 volt-amperes working into an impedance of the order of 6 ohms (minimum).

Discussion

Mr. N. ASHBRIDGE pointed out some of the disadvantages of wire broadcasting, one being that it failed to serve those districts which radio also could not serve. Nevertheless it was useful in certain districts for preventing interference. He also raised several points regarding the method of feeding the programmes, particularly those that were liable to fade, and asked if interference was experienced from electrical apparatus.

Mr. P. J. ADORJAN criticised the author's loading factor and gave details of a few relaying systems.

Mr. R. E. CARPENTER referred to the design of transformer cores described in the paper and discussed their advantages.

CAPT. TIMMIS made some comparisons with line telephone practice and referred to the transformers used in the audio portion of h.f. carrier apparatus. The Post Office had experimented with a small power ($\frac{1}{4}$ watt) carrier transmitter on an ordinary telephone cable, when it was found that this required a three-valve receiver at the subscriber's position.

Mr. BRADLEY asked for information as to disturbance to telephone lines and the effect of earths, etc., on the lines. Mr. E. H. SHAUGHNESSY also referred to the difficulties of fault location on such networks.

Mr. MORECROFT quoted several recent changes of the Post Office specification differing from those given in the paper.

Mr. F. MURPHY referred to the lack of choice offered by wire systems and expressed the view that, while it was possibly a cheap method of obtaining a programme, subscribers after some experience of it would no doubt want to buy a good wireless set.

Mr. E. S. RITTER suggested the use of a "ring-main" system of distribution.

Abstracts and References

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PROPAGATION OF WAVES

TECHNIQUE OF HEIGHT MEASUREMENT OF THE IONOSPHERE BY THE PULSE METHOD [and the Importance of the Pulse Crest].—O. O. Pulley. (*Nature*, 14th April, 1934, Vol. 133, pp. 576–577.)

The writer states that in the pulse method of determining ionospheric heights the crest of the disturbance is the point of greatest importance, since its velocity is the group velocity. In order to make the crest more obvious, he suggests using a double differentiation of the pulse envelope by a double capacitance-resistance potentiometer with appropriate amplifiers, connected across the output of the receiver. The amplifiers may have much narrower band-widths than those usually required for a given accuracy of measurement, and the ground ray may be used to start the time-base when it is necessary to use a self-synchronising system. A record taken when using a differential curve instead of the pulse itself is shown.

EFFECT OF A METEORIC SHOWER ON THE IONOSPHERE.—S. K. Mitra, P. Syam and B. N. Ghose. (*Nature*, 7th April, 1934, Vol. 133, pp. 533–534.)

The writers measured the ionisation content of E layer during the Leonid shower of November, 1933, and found remarkably high electron densities on the days of the shower; there was no marked magnetic disturbance or solar activity on those days and it is suggested that the effect was due to the impact of meteors on the upper atmosphere [*cf.* Skellett, Abstracts, 1933, pp. 92 and 207; Schafer and Goodall, *ibid.*; Malzev, 1933, p. 561 (r-h col.); *see* also Hulburt, 1933, p. 266, and Minohara and Ito, January, p. 30].

THE POLARISATION OF SKY WAVES IN THE SOUTHERN HEMISPHERE [Tests at Jervis Bay, New South Wales].—A. L. Green. (*Proc. Inst. Rad. Eng.*, March, 1934, Vol. 22, No. 3, pp. 324–342.)

On the tests referred to in the first part of the second abstract in 1933 Abstracts, p. 385. These tests, in a practically north-to-south direction, not only form complementary proof of the magneto-ionic theory, but also demonstrate that there must be electrons, in addition to heavy ions, in the Appleton layer, as there are in the Kennelly-Heaviside layer. As regards direction finding, it is to be expected that night errors will be great for directions of propagation parallel to the lines of force of the earth's magnetic field, and less for directions perpendicular to them [for another suggestion as to the influence of the earth's field on direction finding *see* same Abstracts, p. 396]. It is mentioned that "the sense of rotation has never been found to reverse to left-handed in the Jervis Bay experiments, even in very abnormal cases" [*cf.* Eckersley, May Abstracts, p. 260, l-h column].

PHASE INTERFERENCE PHENOMENA IN LOW-FREQUENCY RADIO TRANSMISSION [The Importance of Multi-Path Transmission Effects on Long Waves as well as on Short and Intermediate: Correlation with Solar and Lunar Periods and Their Harmonics: Effects of Magnetic Storms].—G. W. Kenrick and G. W. Pickard. (*Proc. Inst. Rad. Eng.*, March, 1934, Vol. 22, No. 3, pp. 344–358.)

AN AUTOMATIC FIELD-STRENGTH RECORDER FOR LONG WAVES.—Kenrick and Pickard. (*See* above paper.)

ÜBER KURZE UND SEHR KURZE ELEKTRISCHE WELLEN (Short and Ultra-Short Electric Waves [General Account of Methods of Production, Propagation and Use]).—A. Scheibe. (*Physik. Zeitschr.*, 1st March, 1934, Vol. 35, No. 5, pp. 206–215.)

"EXPLORING THE UPPER ATMOSPHERE" [Book Review].—D. Fisk. (*Journ. Scient. Instr.*, April, 1934, Vol. 11, No. 4, p. 131.)

ON THE RESONANCE FREQUENCY OF OSCILLATORY CIRCUITS WITH LEAKY CONDENSER, AND ITS BEARING ON THE MEASUREMENT OF THE DIELECTRIC CONSTANT OF IONISED GAS.—S. S. Banerjee. (*Phil. Mag.*, April, 1934, Series 7, Vol. 17, No. 114, pp. 834–843.)

A critical theoretical and experimental study of the assumption, usually made in experimental investigations of the change of dielectric constant of an ionised gas (*e.g.*, Gutton and Clément—*see* reference given by Rybner, Abstracts, 1929, p. 146; also Gutton, 1930, p. 267; Appleton and Childs,

1931, p. 88; Appleton and Chapman, 1932, p. 398), that "the voltage resonance frequency of the experimental oscillatory circuit is independent of the conductivity of the ionised gas which fills part of the space between the plates of the oscillatory circuit condenser." This assumption is found to be justified only when the whole of the medium between the condenser plates is uniformly conducting. Anomalous results reported by various investigators (*cf.* above references) can be explained as due to the conductivity acquired by the gas owing to ionisation.

SIMULTANEOUS MEASUREMENTS OF THE OZONE DISTRIBUTION IN THE LOWER LAYERS OF THE ATMOSPHERE AT JUNGFRAUJOCH AND LAUTERBRUNNEN [indicating Concentration increasing with Altitude].—Chalonge, Götz and Vassy. (*Comptes Rendus*, 16th April, 1934, Vol. 198, No. 16, p. 1442.)

THEORY ON THE PROPAGATION OF LOW-FREQUENCY WAVES [Change from Metallic to Dielectric Reflection, etc.].—E. Yokoyama and S. Namba. (*Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, pp. 102–103.) Long summary by Plendl, with his own interpolations, of the paper dealt with in 1933 Abstracts, p. 30, r-h column.

THE OPTICAL PROPERTIES OF METALS [Discussion of Modifications introduced by Quantum Theory into Drude's Formulae for Metallic Reflection: Comparison with Experimental Results].—N. F. Mott and C. Zener. (*Proc. Camb. Phil. Soc.*, 30th April, 1934, Vol. 30, Part 2, pp. 249–270.)

MEASUREMENTS IN THE RADIATION FIELD OF A LINEAR ANTENNA EXCITED INSIDE A HOLLOW METALLIC CYLINDER.—Bergmann and Krügel: Wehrich. (*See* under "Aerials and Aerial Systems.")

DISTURBANCE OF ELECTROMAGNETIC WAVES CAUSED BY THE EXISTENCE OF PROLATE SPHEROIDAL CONDUCTORS [Part III of "Action of a Cylinder in Electromagnetic Wave Field"].—H. Kikuchi. (*Journ. I.E.E. Japan*, February, 1934, Vol. 54 [No. 2], No. 547, pp. 133–134: English summary p. 15.) For the previous parts *see* 1932 Abstracts, pp. 461–462.

NOTIZ ZUR THEORIE DER LINEAREN VERZERRUNGEN AUF LEITUNGEN (Note on the Theory of Linear Distortions on Lines [and the Connection of the Attenuation Equivalent and the Phase Velocity by a Constant Factor independent of Frequency]).—J. Fischer. (*Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, pp. 81–83.)

The usual treatment of linear amplitude and phase distortions in a harmonically excited homogeneous line either makes use of trigonometrical substitutions (loss angles) which interfere with the clearness of the picture, or else neglects certain factors, thus limiting the scope of the results. The present Note shows how a clear and complete representation of the physical phenomena can be obtained without either of these disadvantages, and in so doing brings out certain little-known relations. It shows that the attenuation β and phase velocity v are connected by a factor independent of frequency [$\beta = v \cdot \frac{1}{2}(GL + RC)$, where G is the leak conductance per unit length] so that amplitude and phase distortions can be dealt with together. As functions of frequency, β and v move between upper and lower limiting values (equations 7 – 10). The width of the interval thus given is a measure of the distortion in terms of the line constants: interval width

$$= \beta_{max.}/\beta_{min.} = v_{max.}/v_{min.} = \tfrac{1}{2}(\eta + 1/\eta)$$

where $\eta = \sqrt{RC/GL}$. Moreover, one single function (equation 18) is enough to represent the variation with frequency of the two types of distortion. The connection between distortion and damping reduction is discussed at the end of the paper.

SOME TRANSMISSION LINE TRANSIENTS. GRAPHICAL EVALUATION BY FOURIER'S SERIES [Approximation Valid for Power Transmission Lines].—J. A. Strelzoff. (*Journ. Franklin Inst.*, March, 1934, Vol. 217, No. 3, pp. 353–372.)

"By neglecting a relatively small term and thus making a slight simplification in the Heaviside operational equations of line transients, the latter are shown to be reduced to forms involving Fourier series." The general wave form can be drawn graphically. Various cases in power transmission line theory are discussed.

OSCILLATIONS LIBRES DANS UN CÂBLE TÉLÉPHONIQUE (Free Oscillations in a Telephone Cable [Theory and Experimental Verification of Oscillations produced by the Sudden Introduction of an Inductance]).—M. Marro. (*Rev. Gén. de l'Élec.*, 14th April, 1934, Vol. 35, No. 15, pp. 491–493). Further development of the work dealt with in 1933 Abstracts, p. 616, r-h column, and below.

TUNED POWER LINES: FIVEFOLD GAIN IN EFFICIENCY.—M. Marro. (*Electrician*, 6th April, 1934, Vol. 112, No. 2914, p. 472.) *See* also preceding abstract.

DISCUSSIONS ON "ATTENUATION AND DISTORTION OF WAVES."—L. V. Bewley. (*Elec. Engineering*, March and April, 1934, Vol. 53, Nos. 3 and 4, pp. 471–473 and 595–598.) *See* February Abstracts, p. 86, r-h column.

DIE EINDRINGTIEFE VON HOCHFREQUENZSTRÖMEN UND MAGNETFLÜSSEN IN STARKSTROMLEITERN (The Penetration of High-Frequency Currents and Magnetic Fluxes in Power-Line Conductors).—F. Loebner. (*Veröffent. a.d. Gebiet der Nachrichtentech.*, No. 3, Vol. 3, 1933, pp. 253–262.)

ON THE REFRACTION AND REFLECTION OF WAVES [according to the Theory of Propagation by "Contact Elements"].—E. Vessiot. (*Comptes Rendus*, 19th March, 1934, Vol. 198, No. 12, pp. 1120–1122.)

THE COUPLES EXERTED BY CIRCULARLY POLARISED LIGHT.—E. Henriot. (*Comptes Rendus*, 19th March, 1934, Vol. 198, No. 12, pp. 1146–1148.)

NEGATIVE RESULT OF AN ATTEMPT TO COMBINE TWO QUANTA OF VISIBLE LIGHT INTO ONE QUANTUM OF ULTRA-VIOLET.—C. J. Gorter. (*Physica*, January, 1934, Vol. 1, No. 3, pp. 199–200 : in English.)

ATMOSPHERICS AND ATMOSPHERIC ELECTRICITY

AUDIO-FREQUENCY ATMOSPHERICS [Newfoundland, Ireland, Key West/Havana and Eclipse Observations].—E. T. Burton. (*Bell Lab. Record*, April, 1934, Vol. 12, No. 8, pp. 226–229). For previous papers *see* February Abstracts, p. 86.

DISCUSSION OF THE TERRESTRIAL OR COSMIC ORIGIN OF ATMOSPHERICS.—Heinrich-Hertz Society. (*E.N.T.*, February, 1934, Vol. 11, No. 2, p. 67 : summary only.)

CONNECTION BETWEEN RAPID MAGNETIC DISTURBANCES AND ATMOSPHERICS : PROJECTED EXPERIMENTS.—Heinrich-Hertz Society. (*See* abstract under "Miscellaneous," section 3.)

SUMMER THUNDERSTORM SURVEY [Notice of Annual Census].—S. M. Bower. (*Electrician*, 6th April, 1934, Vol. 112, No. 2914, p. 476.)

ELECTRICAL CONDUCTIVITY AND FIELD OF THE AIR NEAR A FIRE [in connection with the Incidence of Lighting].—G. Viel. (*Rev. Gén. de l'Élec.*, 24th March, 1934, Vol. 35, No. 12, pp. 379–381.)

DO LIGHTNING RODS PREVENT LIGHTNING ?—J. Zeleny. (*Science*, 23rd March, 1934, Vol. 79, No. 2047, pp. 269–271.) Prompted by the Whitehead/Lloyd argument referred to in May Abstracts, p. 262, l-h column. *See* also Skilling, *ibid.*, 30th March, 1934, pp. 293–294.

HOW TO DESIGN GROUND WIRES FOR DIRECT STROKE PROTECTION.—L. V. Bewley. (*Elec. World*, 17th March, 1934, Vol. 103, No. 11, pp. 397–399.)

DISCUSSIONS ON "LIGHTNING MEASURED ON 4-KV OVERHEAD CIRCUITS."—H. Halperin and K. B. McEachron. (*Elec. Engineering*, March and April, 1934, Nos. 3 and 4, pp. 465 and 616–617.) *See* March Abstracts, p. 145, r-h column.

DISCUSSIONS ON "HEAVY SURGE CURRENTS—GENERATION AND MEASUREMENT."—P. L. Bellaschi. (*Elec. Engineering*, March and April, 1934, Vol. 53, Nos. 3 and 4, pp. 481–482 and 622–624.) *See* March Abstracts, p. 145, r-h column.

THUNDERSTORMS AND THE PENETRATING RADIATION.—E. C. Halliday. (*Proc. Camb. Phil. Soc.*, 30th April, 1934, Vol. 30, Pt. 2, pp. 206–215.)

Experiments are described which consisted in synchronising the expansion of a Wilson cloud chamber with a lightning flash. Such expansions give a greater frequency of particle capture than do random expansions, and the frequency is increased by taking only those thunderstorms occurring to the west of the laboratory. The magnitude of the effect is similar to that found by Schonland and Viljoen in S. Africa (1933 Abstracts, p. 442, l-h column). The most favoured direction of arrival of the particles is from the north, at a large angle to the direction of the earth's magnetic field.

RESULTS OF THE DUTCH COSMIC-RAY EXPEDITION, 1933.—J. Clay. (*Physica*, March, 1934, Vol. 1, No. 5, pp. 363–382 : in English.)

COSMIC RAY RECORDS NEAR INNSBRUCK : ANALYSIS OF FLUCTUATIONS : METEOROLOGICAL AND SOLAR INFLUENCES.—Hess, Steinmaurer, and Graziadei. (*Physik. Ber.*, 15th Feb. 1934, Vol. 15, No. 4, pp. 302, 302–303, and 303.) *See* also February Abstracts, p. 87, r-h column.

ANALYSIS OF COSMIC RAY DEFLECTION EXPERIMENTS : THE MAGNETIC DEFLECTION EXPERIMENTS OF CURTISS AND OF MOTT-SMITH [Computation of Proportion of Electrons of Given Energy eliminated by Application of Magnetic Field].—W. E. Danforth, Jr. (*Journ. Franklin Inst.*, March, 1934, Vol. 217, No. 3, pp. 331–345.) For reference to the experiments in question *see* Abstracts, 1933, p. 152 ; 1932, p. 278 ; and *Phys. Review*, 1930, Vol. 35, p. 1125.

THE PATH OF A SECONDARY COSMIC-RAY CHARGED PARTICLE IN THE EARTH'S MAGNETIC FIELD.—I. S. Bowen. (*Phys. Review*, 15th March, 1934, Series 2, Vol. 45, No. 6, pp. 349–351.)

VACUUM TUBE CHARACTERISTICS IN RELATION TO THE SELECTION OF COINCIDENT PULSES FROM COSMIC RAY COUNTERS.—L. Fussell, Jr., and T. H. Johnson. (*Journ. Franklin Inst.*, April, 1934, Vol. 217, No. 4, pp. 517–524.)

Description of a circuit, and characteristics of the valves used therein, to satisfy the condition that "the smallest output pulse resulting from discharges in all of the counters shall be greater than the largest output pulse resulting from discharges in all but part of the counters." An abstract of this paper was referred to in May Abstracts, p. 270, r-h column.

THE MECHANISM OF COSMIC-RAY COUNTER ACTION [Photon passing through Counters releases Secondary Electrons whose Separate but almost Simultaneous Action on Counters is responsible for Observed Coincidences].—C. D. Anderson, R. A. Millikan, S. Neddermeyer and W. Pickering. (*Phys. Review*, 15th March, 1934, Series, 2, Vol. 45, No. 6, pp. 352–363.)

INVARIANTS OF [Cosmic Radiation] COUNTERS [Reduction of Data by Simple Calculation].—L. Jánossy. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 5/6, pp. 372–388.)

NOTES ON POSITIVE ELECTRONS AND COSMIC RAYS [Short Survey of New Researches].—E. L. Hill. (*Review Scient. Instr.*, No. 11, Vol. 4, 1933, pp. 570–571.)

EXPERIMENTS WITH A SIMPLE TYPE OF CLOUD CHAMBER.—P. C. Ho and E. C. Halliday. (*Proc. Camb. Phil. Soc.*, 30th April, 1934, Vol. 30, Pt. 2, pp. 201–205.)

This new type of cloud chamber has been described by C. T. R. Wilson [Proc. Roy. Soc. (A), 1933, Vol. 142, p. 88]. The experiments described here show that photographs can be obtained over a range of final pressures in the chamber extending from atmospheric down to 7 cm of mercury.

POLAR AURORAS AND THE COSMIC RAYS: SCORESBY SOUND OBSERVATIONS.—A. Dauvillier. (*Bull. de la Soc. franç. des Élec.*, April, 1934, Vol. 4, Series 5, No. 40, pp. 383–404.) For a *Comptes Rendus* Note on these observations *see* March Abstracts, p. 146.

NEW RESULTS ON THE GREEN RAY OF THE NON-POLAR AURORA IN THE NIGHT SKY.—H. Garrigue. (*Comptes Rendus*, 16th April, 1934, Vol. 198, No. 16, pp. 1398–1400.)

FOG AND FROST PREVENTION BY ELECTRICITY [Results in California].—W. Haight. (*World Power*, March, 1934, Vol. 21, No. 123, pp. 118–119: paragraph only.)

PROPERTIES OF CIRCUITS

KENNZEICHNUNG UND MESSUNG DER DÄMPFUNG VON SCHWINGUNGSSYSTEMEN (The Characterisation and Measurement of the Damping of Oscillatory Systems [Mechanical and Electrical: the Introduction of "Damping Angle" and Its Convenience: Methods of Measurement]).—W. Späth. (*Archiv f. Elektrot.*, 5th April, 1934, Vol. 28, No. 4, pp. 257–262.)

The new term "damping angle" is derived from the vector diagram given by the theory of forced oscillation. Its tangent gives a measure of the damping. For an electrical circuit $Z = \tan \epsilon$ = ohmic resistance $/\sqrt{L/C}$, conveniently replacing the usual $\delta = R/2L$, while for a mechanical system in which ωm is the resistance due to inertia and c/ω the resistance due to the springing, $Z = \tan \epsilon$ = frictional resistance$/\sqrt{cm}$.

STABILITY OF RESISTANCE-COUPLED AMPLIFIERS [Retroaction due to Common Anode Supply: Theory giving Conditions of Stability: Graphs for Calculation of Decoupling Circuits].—W. Baggally. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, pp. 179–182.)

INDUCTANCE AT HIGH FREQUENCIES AND ITS RELATION TO THE CIRCUIT EQUATIONS [Application of L.F. Theory to H.F. Wire Circuits requires Modification of Term $-L \cdot dI/dt$ by Change in L and Introduction of a New Term $N \cdot d^2I/dt^2$, where N is a New Parameter: "Radiactance" as a Substitute for Radiation Resistance].—J. G. Brainerd. (*Proc. Inst. Rad. Eng.*, March, 1934, Vol. 22, No. 3, pp. 395–401.)

MUTUAL INDUCTANCE OF TWO CIRCULAR CURRENTS IN ANY RECIPROCAL POSITION.—J. Hak. (*L'Onde Élec.*, January, 1934, Vol. 13, No. 145, pp. 19–42.)

Snow's general formula has an apparently simple form, but its series development to obtain an expression suitable for numerical calculation is rather laborious. The writer, starting from Neumann's formula, obtains an expression directly employable for calculation: he begins by deriving an expression (formula 11) applying to two distant circles, and then transforms it, when necessary, into a more rapidly converging expression holding for circles at a smaller distance (formula 12). He shows that these expressions, when applied to special cases, coincide with those obtained for those cases by quite different methods. His formulae are suitable for practical use even when circular coils, instead of merely circles, are involved.

REMARKS ON THE SELF CAPACITY OF COILS.—Cassou and Cayrel. (*See* under "Measurements and Standards.")

STRUCTURAL ANALYSIS BY ELECTRIC CIRCUIT ANALOGIES.—V. Bush. (*Journ. Franklin Inst.*, March, 1934, Vol. 217, No. 3, pp. 289–329.)

INVARIANTS OF QUADRICS AND ELECTRICAL CIRCUIT THEORY.—R. S. Burington. (*Phys. Review*, 15th March, 1934, Series 2, Vol. 45, No. 6, p. 429.)

SU ALCUNE PROPRIETA E POSSIBILITA DI UN CIRCUITO A TRIODI (Some Properties and Possibilities of a Triode Circuit [Two Similar Triodes in Opposition as a Wattmeter Circuit]).—F. Neri. (*L'Elettrotec.*, 25th Jan. 1934, Vol. 21, No. 3, pp. 58–62.)

ON THE RESONANCE FREQUENCY OF OSCILLATORY CIRCUITS WITH LEAKY CONDENSER, AND ITS BEARING ON THE MEASUREMENT OF THE DIELECTRIC CONSTANT OF IONISED GAS.—Banerjee. (*See* under "Propagation of Waves.")

ON THE DURATION OF THE DISCHARGE OF A BATTERY OF CONDENSERS IN A METALLIC WIRE.—G. Vaudet. (*Comptes Rendus*, 26th March, 1934, Vol. 198, No. 13, pp. 1217–1219.)

STUDY OF THE MAGNETIC FIELD PRODUCED BY A LOW-FREQUENCY CURRENT CIRCULATING IN A CONDUCTOR IN THE PRESENCE OF THE GROUND.—C. Bourgonnier. (*Bull. de la Soc. franç. des Élec.*, March, 1934, Vol. 4, Series 5, No. 39, pp. 261–296.)

TRANSIENTS IN MAGNETIC SYSTEMS.—C. F. Wagner. (*Elec. Engineering*, March, 1934, Vol. 53, No. 3, pp. 418–425.)

ON THE THEORY OF AN *N*-WINDING TRANSFORMER [assuming Pure Reactance Windings, Perfect Couplings and Linear Loads].—L. E. Brown. (*Physics*, March, 1934, Vol. 5, No. 3, pp. 61–63.)

KETTENLEITER MIT GESCHLOSSENEN EISENKERNSPULEN (Filters with Closed-Iron-Core Coils [and Their Calculation by Graphical Analytical Methods]).—R. Oetker. (*Archiv f. Elektrot.*, 5th April, 1934, Vol. 28, No. 4, pp. 201–205.)

ELECTRIC WAVE FILTERS FOR HIGH FREQUENCIES [Replacement of Tuned Circuits in Series by Wave Filter on Audio-Frequency Lines: Difficulty of Small Inductances overcome by use of Very Small specially Shielded Condensers and Internal Re-matching of Impedances].—C. L. Frederick. (*Electronics*, March, 1934, pp. 84–85 and 90.)

ANPASSUNGSVIERPOLE UND IHRE ÜBERTRAGUNGSTECHNISCHE VERWENDUNG (Matching Quadripoles and Their Use in Transmission Technique).—German Post Office. (*T.F.T.*, January and February, 1934, Vol. 23, Nos. 1 and 2, pp. 2–7 and 33–38.) Based on Zobel's paper (1931 Abstracts, pp. 436–437).

THE RECIPROCITY LAWS OF LINEAR NETWORKS.—H. Bitter. (*T.F.T.*, March, 1934, Vol. 23, No. 3, pp. 59–65.)

TRANSMISSION

RÉSONANCE ET STABILISATION DES ÉLECTRONS DANS LES TUBES À VIDE (Resonance and Stabilisation of the Electrons in Valves).—G. Gorélik. (*Physik. Zeitschr. der Sowietunion*, No. 3, Vol. 4, 1933, pp. 569–570.)

Referring to the resonance method of Gill and Donaldson (1933 Abstracts, p. 444) "which may render great service in the study of the phenomena occurring in transmitting valves at very high frequencies," the writer considers a valve at whose electrodes a sinusoidal voltage $V(x, t)$ of frequency ω is superposed on the battery d.c. potentials. Assuming that the electron can execute small free oscillations, he obtains equation 3, the equation of an oscillator with periodically variable parameters, subjected to the action of a given alternating force. He takes the simplest case where the electron differs little from a harmonic oscillator (of natural frequency $\omega_0 = \sqrt{b_0}$), the non-linear terms of equation 3 being neglected. "The theory of linear equations with periodic coefficients then shows that phenomena of 'parametric' resonance may occur, the most marked taking place when $\omega = 2\omega_0$, and phenomena of 'ordinary' resonance, the most marked occurring when $\omega = \omega_0$." Taking into account the non-linear terms of equation 3, "parametric" resonances of higher order are indicated. In certain cases several different types of resonance may occur simultaneously.

If the potential is at each instant symmetrical with respect to $x = 0$, V contains no terms of odd degree in x, and "ordinary" resonance cannot occur: the only resonance phenomena will be the 'parametric" type arising from the terms of V of even degree. A practically symmetrical potential can be obtained in a diode with negative outside electrode, where the electrons can oscillate around the inner electrode; or in a triode with strongly negative plate and weakly negative grid, where the electrons can oscillate round the filament and through the grid. The theory of linear equations with periodic coefficients shows also that if $b_0 < b$ (unstable equilibrium) the electrons can be stabilised by a small potential of suitable amplitude and frequency.

20 KW OF ULTRA-HIGH-FREQUENCY POWER FROM THE STANDING-WAVE OSCILLATOR BETWEEN 40 AND 100 Mc/s.—Mouromtseff. (*See* abstract under "Miscellaneous.")

ON SOME METHODS OF INCREASING THE OUTPUT OF ULTRA-SHORT-WAVE OSCILLATORS [of Modified Holborn 2-Valve Type].—S. Ohtaka. (*Journ. I.E.E. Japan*, February, 1934, Vol. 54 [No. 2], No. 547, pp. 87–90: English summary p. 9.)

Further work on the circuit dealt with in May Abstracts, p. 265. "Efficient and stable oscillation is obtained not only by carefully arranging the connecting wires, but also by shunting the filament terminals with suitable condensers and by inserting a parallel resonance circuit between the filament circuits. . . . A new method of modulation will be obtained if a condenser microphone is inserted between the plate conductor and the grid conductor, or between one of them and a suitable tap of the parallel resonance circuit."

GENERATION OF ULTRA-SHORT AND MICRO-WAVES BY A DIODE WITH CATHODE SURROUNDING ANODE.—McPetrie. (*See* abstract under "Valves and Thermionics.")

ELECTRON-COUPLED TRANSMITTER [and the Screening Efficacy of the Suppressor Grid].—R. A. Yeo: Hodgson. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 193.) Continuation of the discussion referred to in April Abstracts, p. 205, l-h column.

ÜBER KURZE UND SEHR KURZE ELEKTRISCHE WELLEN (Short and Ultra-Short Electric Waves [General Account of Methods of Production, Propagation and Use]).—A. Scheibe. (*Physik. Zeitschr.*, 1st March, 1934, Vol. 35, No. 5, pp. 206–215.)

BEAM REFLECTOR ARRANGEMENT FOR ULTRA-SHORT WAVES.—Machinerien en Apparaten Fab. Company. (*See* under "Aerials and Aerial Systems.")

DER AUFSCHAUKELVORGANG BEI EINER SELBSTERREGTEN RÖHRENSCHALTUNG (The Building-Up Process in a Self-Excited Valve Circuit).—W. Kautter. (*Telefunken-Zeit.*, March, 1934, Vol. 15, No. 66, pp. 46–49.)

Taking Fig. 41 as the essential circuit diagram of a self-excited oscillator, the writer derives the equivalent circuit Fig. 42, which consists of a parallel connection of various pure conductances and susceptances (*see* 1933 Abstracts, p. 447), the retroaction being represented as a negative conductance as described in the writer's work just referred to. Considering this circuit, and making use of the fact that at any instant the sum of the loss conductances and building-up conductances must be equal to the retroaction equivalent conductance, he arrives at formula 2; introducing this into the solution of equation 1 representing the building-up of an oscillation, he obtains equation 6 for the building-up time, on the assumption of a parabolic form for the slope-curve of the oscillation characteristic. From this he derives the practical formula 7.

As an example of the use of this formula the

writer takes the case of a circuit whose tuning capacity is 200 $\mu\mu$F and whose resonance conductance is 10^{-3} ohm^{-1}; for an a.c. grid potential of 2 volts the slope decreases to 30%, the final amplitude is taken as 1.5 volts and the initial amplitude (circuit noise) as 0.5 microvolt. From the formula, the building-up time comes out at 3.32×10^{-3} second. This is on the assumption that the building-up process is complete when the amplitude reaches within 1% of the theoretical final value. Fig. 44 shows how the building-up time varies with the percentage assumed. The writer then discusses the factors affecting the length of the building-up time, and with the help of Fig. 45 (showing the general course of events in a building-up process without any acceleration by external influences) shows that for 60% of the time the curve is horizontal and that then the amplitude rises suddenly, the curve bending over again during the final 9%, thus indicating that the conductance is not independent of the amplitude. But a neglect of this variation only leads to a 9% error, while the artificial application to the grid of a fourth part of the final amplitude will diminish the building-up time to one-fifth. Thus the small importance of the rounding-off of the top of the curve of Fig. 45 indicates that it does not matter what form is attributed to the oscillation characteristic.

MANIPULATION DES ÉMETTEURS RADIOTÉLÉGRAPHIQUES DE GRANDE PUISSANCE (The Keying of High-Power Radiotelegraphic Transmitters).—G. Fayard. (*L'Onde Élec.*, January, 1934, Vol. 12, No. 145, pp. 43–51.)

Author's summary:—"After showing that it appears insufficient, for a good utilisation of the plant and for the production of high-quality signals, to keep the supply plant at constant load, usually by means of absorbing valves and resistances, the writer points out that it is desirable, in addition, to keep the transmitting valves working at a constant anode dissipation" [since otherwise the variations in dissipation introduce concomitant variations of the internal valve characteristics which show themselves by variations in frequency —in the case of a self-oscillating stage—or in amplitude—in the case of an amplifying stage].

"Passing by those systems employing a 'compensation' wave, which satisfy this condition but introduce non-essential transmissions whose frequencies generally fall outside the allotted band, the writer describes an arrangement which is applicable equally to self-oscillating and to amplifying stages and which allows the valves to function at constant efficiency, while the power taken from the supply source is itself constant at every instant of the keying régime." The system described also effects a considerable reduction in initial cost and maintenance, by suppressing the absorbing valves used in most other systems. These valves, although differing in characteristics from the transmitting valves, are approximately equal to the latter in nominal power and can hardly function at a higher efficiency. In the writer's system they are replaced by a generating stage of nominal power not more than one-tenth of that of the transmitting valves.

Fig. 4 shows the system applied to a transmitter with amplifying stages. E_1 represents the penultimate, E_2 the final stage. The valves of E_2 are connected to a double system of impedances z_1, Z_1 and z_2, Z_2, suitable for the two working frequencies and of such values that for the one frequency f, z_2 is negligible compared with z_1 and Z_2 negligible compared with Z_1, and *vice versa* for the other frequency F. The small valve generator referred to above is shown at G, and oscillates at frequency F. When G is not oscillating and E_1 is functioning normally, E_2 will pass the full power to the aerial, a negligible amount of energy being lost in the resistance R_2 of the inductance Z_2. If, however, E_1 has its grid circuit strongly negative and cannot excite E_2, a setting in action of G makes E_2 transfer to R_2 the energy previously passed on to the aerial. For medium and short wavelengths G may oscillate at a frequency between 10 000 and 30 000 c/s, but alternative values for special cases are discussed.

METHOD OF TRANSMITTING OR RECORDING ACOUSTIC OSCILLATIONS [using Two Wave Trains of Different Frequencies with Frequency Modulation of Opposed Phase].—Telefunken. (German Pat. 586 083, pub. 16.10.1933: *Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 105.)

METHOD OF SHORT-WAVE SUPPRESSED CARRIER TRANSMISSION IN WHICH THE SHORT-WAVE CARRIER IS OBTAINED FROM A LONG WAVE UNAFFECTED BY FADING.—Telefunken: Schröter. (*Ibid.*, p. 105.)

VUE D'ENSEMBLE SUR LES DIVERS PROCÉDÉS EMPLOYÉS POUR AUGMENTER LE RENDEMENT DES ÉMETTEURS DE RADIODIFFUSION (Survey of the Various Methods employed for Increasing the Efficiency of Broadcasting Transmitters [chiefly Modulation Methods]).—J. Loeb. (*Ann. des P.T.T.*, February, 1934, Vol. 23, No. 2, pp. 132–144.)

Including the S.I.F. and Kraemar/Lorentz modulation systems (R and E both constant, carrier automatically reinforced at the moment when the modulation passes a certain point and the amplitude of the emitted wave is in danger of not growing with sufficient rapidity): the Chireix dephasing method (R variable, E constant): anode-control systems (R constant, E variable: at present only attained by absorbing a large amount of energy in the modulator valves): and the "slowly variable carrier" systems, one of which is being studied in Germany. *See* also Ditcham, March Abstracts, pp. 150–151.

THE A.C. VALVE BRIDGE AS A MODULATOR [including a Method by which Carrier appears only on Modulation].—Reed. (*See* abstract under "Measurements and Standards.")

AN ANALYSIS OF EFFICIENT MODULATION [and the Increase of Efficiency in Constant-Current Modulation by replacing Impedance Coupling Device by Transformer of Suitable Ratio to give Matched Loads].—E. N. Dingley, Jr. (*Electronics*, March, 1934, pp. 78–79 and 81.)

SOME NOTES ON ADJACENT CHANNEL INTERFERENCE [resulting from Non-Linearity due to Excessive Modulation, Generation of Spurious Radio Frequencies, Maladjustment or Bad Design of Transmitter and Associated Equipment, etc. : restricting Further Development of Receiver Selectivity and Fidelity : Remedies].—I. J. Kaar. (*Proc. Inst. Rad. Eng.*, March, 1934, Vol. 22, No. 3, pp. 295–313.)

DISTORTION DUE TO PHASE MODULATION IN BROADCASTING TRANSMITTERS. — Heinrich - Hertz Society. (*See* abstract under "Miscellaneous," section 7.)

HIGH-FIDELITY TRANSMITTERS : THE EFFECT OF HIGH-FIDELITY REQUIREMENTS ON TRANSMITTER DESIGN.—J. E. Young. (*Rad. Engineering*, March, 1934, Vol. 14, No. 3, pp. 18–19.)

EXAMINATION OF MODULATION BY A SIMPLE CATHODE-RAY OSCILLOGRAPH, WITHOUT LINEAR TIME BASE : HORIZONTAL SWEEP-VOLTAGE OBTAINED DIRECTLY FROM MODULATOR.—J. Millen and D. H. Bacon. (*QST*, April, 1934, Vol. 18, No. 4, pp. 27–30 and 80.)

SUPPRESSOR-GRID MODULATION : ITS APPLICATION TO LOW-POWER TELEPHONY, AND FUTURE POSSIBILITIES.—J. J. Lamb. (*QST*, March, 1934, Vol. 18, No. 3, pp. 19–22.)

THE CALCULATION OF MODULATION PRODUCTS.—II [Extension to Amplitude- and Frequency-Modulated Waves].—A. C. Bartlett. (*Phil. Mag.*, March, 1934, Series 7, Vol. 17, No. 113, pp. 628–633.) For Part I *see* January Abstracts, p. 40, r-h column.

REPEATER FOR BROADCASTING TRANSMISSION [over Long Overhead Lines].—C. Anjou. (*L.M. Ericsson Review*, No. 1, 1934, pp. 40–42.)

APPLICATIONS OF THE DYNATRON [and the Discrepancy between Theory and Experimental Results as regards Frequency].—J. Groszkowski : Scroggie. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, pp. 193–194.) Continuation of the discussion referred to in April Abstracts, p. 205, l-h column.

ON THE STABILISATION OF FREQUENCY IN TRIODE OSCILLATORS [by Purely Electrical Means].—E. Divoire and P. Baudoux. (*L'Onde Élec.*, February, 1934, Vol. 13, No. 146, pp. 53–79.)

"Among the causes of instability shown by the various experimenters who have studied the question, some are connected with variations in the load circuits or in the geometrical characteristics of the valve ; others with variations of the parameters of the latter." The writers confine themselves to the second class, and point out that most workers have made use of the convenient equations giving ω at the oscillation threshold, although this is a condition not generally holding in practice : "this hypothesis masks a large part of the phenomena." Neglect of grid current, another common device, rules out the study of the most powerful methods of stabilisation—those acting in the grid circuit. The present paper gives a mathematical treatment advancing step by step towards practical conditions, working always with the classical arrangement of an oscillating circuit in the plate lead, coupled inductively to the grid circuit.

At an early stage of the analysis, before grid current is taken into account, the following factors favouring stability are encountered :—gradual valve slope, weak coupling, low resistance of oscillatory circuit, small L and large C : *the first device for artificial stabilisation* is to imitate a higher internal valve resistance by introducing a resistance into the plate circuit, outside the oscillatory circuit. In the next stage, taking grid current into account, equation 30 shows that the stability is the better, the nearer the working point is to the oscillation threshold, and that it is also better in the absence of grid current : *the second device for artificial stabilisation* is to diminish the grid inductance and increase the filament/grid resistance, by inserting a series resistance in the grid circuit. Further examination shows that if the grid circuit is a circuit resonating to the frequency ω, the system behaves (in a first approximation) as if there were no grid current : *the third and most effective device* is therefore to introduce a condenser (shunted by a very high resistance) in series with the grid inductance. The higher the shunting resistance, the more effective the stabilisation. The arrangement is found to be effective even when the condenser differs from the optimum (resonant) value, for if the condenser is too small the shunting resistance acts by itself as the "second device" ; if the condenser is increased beyond the resonant value, the grid-circuit impedance only slowly tends towards its limiting value. Moreover, the grid current is actually complex in form, with important harmonics, and the experimental work shows that stabilisation can be attained with the grid circuit tuned to a frequency double that of the transmitter.

The last half of the paper describes the experimental confirmation of the theoretical results. In a laboratory oscillator, where most of the devices can be included, stabilities of the order of 10^{-6} can be maintained over comparatively long periods.

VALVE OSCILLATORS OF STABLE FREQUENCY [Book Review]. — F. M. Colebrook. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 192.)

THE SEARCH FOR VERY CONSTANT BUT ADJUSTABLE FREQUENCIES : RESEARCHES ON THE "MITNAHME" PHENOMENON. — Heinrich-Hertz Society. (*See* abstract under "Miscellaneous," section 8.)

RESEARCHES ON ROCHELLE SALT OSCILLATORS. (*Ibid.*, section 9.)

UNTERSUCHUNG ÜBER FREQUENZ, AMPLITUDE UND STABILITÄTSBEREICH DER QUARZGESTEUERTEN SENDER (Investigation of Frequency, Amplitude, and Stability Range of the Quartz-controlled Transmitter). — A. K. Daryusch. (*Berlin Thesis*, 1934 : at Patent Office Library, London.)

BUFFER STAGE IN TOURMALIN-CONTROLLED ULTRA-SHORT-WAVE TRANSMITTER. — Heinrich-Hertz Society. (*See* abstract under "Miscellaneous," section 2.)

A One-Tube Crystal-Control Transmitter: Practical Two-Band Operation with One Crystal [" Tri-Tet " Oscillator Circuit].—G. Grammer. (*QST*, March, 1934, Vol. 18, No. 3, pp. 8–12 and 88.) *See* Lamb, January Abstracts, p. 34, l-h column.

Telefunken Short-Wave Amateur Equipments.—W. L. Baumgarten. (*Telefunken-Zeit.*, March, 1934, Vol. 15, No. 66, pp. 50–51.)

The Calculation of Class C Amplifier and Harmonic Generator Performance of Screen-Grid and Similar Tubes.—Terman and Ferns. (*See* under " Valves and Thermionics.")

RECEPTION

Discussion on Synchronous Reception and Its Applications.—de Bellescize. (*Bull. de la Soc. franç. des Élec.*, February, 1934, Vol. 4, Series 5, No. 38, pp. 160–170.) For previous work *see* Abstracts, 1933, p. 38: also February, p. 91, l-h column.

The A.C. Valve Bridge as a Detector of C.W. Signals.—Reed. (*See* abstract under " Measurements and Standards," p. 333.)

A Possible Application of the Principle of Audio-Frequency Super-Regeneration to Reception in Aircraft and Motor Cars [Suggested Use of Magneto " Interference " to provide the Quenching Frequency (around 40 c/s)].—Y. Marrec. (*L'Onde Élec.*, January, 1934, Vol. 13, No. 145, p. 18.)

Die Ausschaltung des starken Ortssender: der Brückensperrkreis (Cutting Out the Strong Local Station: the Bridge Wave-Trap [with Differential Transformer Details]).—P. Nützler. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 103–105.)

With the arrangement described, using a poorly screened receiver at 5 km from a 100-kw station, distant reception was possible at a frequency ± 20 kc/s away from the local signals. Ordinary wave-trap circuits were quite inadequate: " only the production of an opposed-phase current, as provided by the bridge wave-trap, can give successful results."

High Ohmic Resistance between Aerial and Receiver very successful in Cutting Out Local Station: even Brings in Distant Stations hitherto Unheard.—W. Nestel. (*Die Sendung*, 6th April, 1934, Vol. 11, No. 15, p. 292.)

Some Notes on Adjacent Channel Interference [Transmission Defects restricting Further Development of Receiver Selectivity and Fidelity].—Kaar. (*See* under " Transmission.")

The Spontaneous Background Noise in Amplifiers due to Thermal Agitation and Shot Effects.—E. B. Moullin and H. D. M. Ellis. (*Journ. I.E.E.*, April, 1934, Vol. 74, No. 448, pp. 323–348: Discussion pp. 348–356.)

The full paper, a *Wireless Engineer* summary of which was referred to in March Abstracts, p. 152, r-h column. In an Appendix, Moullin announces a subsequent experimental confirmation of the expression (equation 18) obtained for the shot voltage.

" Rundfunkempfangstörungsfrei " (Undisturbed Broadcast Reception: the Elimination of Industrial Interference [Book Review]).—E. Schwandt. (*Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 108.)

Empfangsstörungen durch Zündanlagen von Verbrennungsmotoren (Radio Interference from the Ignition System of Internal-Combustion Motors [and the Production of Long-Wave as well as Short-Wave Interference].—H. Viehmann. (*Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, pp. 85–87.)

Ignition interference becomes more and more severe the shorter the signal wavelength, but even at long wavelengths interference has often been observed which has been attributed, without definite proof, to this cause. The cathode-ray oscillograph tests here discussed prove that under certain conditions, in the circuit of the installation and in the spark plug, the wave-trains produced by " back-discharges " (following the main spark), although themselves only causing short-wave interference (*e.g.* 3–15 m), may occur at such intervals as to interfere in the 300–3 000 m region. The use, in aircraft engines, of a spark-over distributor instead of the carbon-brush type is an additional cause of back-discharges, and therefore adds to the chance of long-wave interference; but its other advantages are great enough to render its rejection on these grounds undesirable.

Auto Ignition Interference [and Its Cure by Shielding, Suppressors, or Resonant or Anti-Resonant Circuits].—R. D. Rettenmeyer. (*Rad. Engineering*, March, 1934, Vol. 14, No. 3, p. 20.)

Radioelectric Interference: the Situation of Electrical Enterprises, in France, with regard to the Decree of 1st December, 1933.—J. C. de Fabel. (*Rev. Gén. de l'Élec.*, 24th March, 1934, Vol. 35, No. 12, pp. 405–407.)

The Protection of Broadcast Reception against Industrial Interference.—P. Baize. (*Ann. des P.T.T.*, March, 1934, Vol. 23, No. 3, pp. 201–221.)

Interference with Radio Communication introduced by High-Tension Power Lines.—Ch. Bruniaux and R. Petit. (*Ibid.*, pp. 222–231.)

The Suppression of Interference caused by Baudot Telegraph Equipment.—H. Subra. (*Ibid.*, pp. 232–245.)

Broadcast Interference from 6-Phase Mercury-Vapour Rectifiers for Lighting Networks, with Methods of Prevention.—E. T. Glas. (*Teknisk Tidskrift*, 7th April, 1934, Vol. 64, No. 14, Supp. pp. 55–59.)

BRIDGE CONNECTION FOR KEEPING OUT MAINS' NOISES FROM MAINS-OPERATED RECEIVERS. —Philips Company. (French Pat. 759 289, pub. 31.1.1934: *Rev. Gén. de l'Élec.*, 31st March, 1934, Vol. 35, No. 13, pp. 103–104 D.)

ELIMINATION OF MAINS NOISES DUE TO GRID BIAS FROM HEATING CIRCUIT, IN D.C.-HEATED VALVES, BY THE USE OF TWO TAPPING POINTS, ONE ABOVE AND ONE BELOW THE POTENTIAL OF FILAMENT MID-POINT.—G. Seibt Company. (German Pat. 573 136: *Funktech. Monatshefte*, March, 1934, No. 3, p. 128.)

DIE GLIMMLAMPE ALS OPTISCHER ANZEIGER—INDIKATORGLIMMLAMPE (The Glow-discharge Lamp as an Optical Indicator—the "Indicator" Gaseous Discharge Lamp).—W. Pohle and H. Straehler. (*E.T.Z.*, 22nd March, 1934, Vol. 55, No. 12, pp. 295–297.)

The writers deal particularly with the "indicator" lamp made by the Osram Company. The rod-shaped cathode has two ring electrodes surrounding it, the one further from the socket being the anode and the other an auxiliary electrode; a two-electrode form, dispensing with the auxiliary electrode, is also possible. Various characteristic curves are given. Although the most obvious and immediate application of these lamps is for "optical tuning" in broadcast receivers, there are many other uses; *e.g.* as indicators in electrical medical apparatus, in rapid commercial checking of comparative resistances, etc. Two such lamps in push-pull, combined with a rotating mirror, form a useful oscillograph.

HIGH-FIDELITY RECEIVERS [Design Considerations: Introduction to a Series of Articles].—A. G. Hanley. (*Rad. Engineering*, March, 1934, Vol. 14, No. 3, pp. 14–15.)

LAST YEAR'S PROGRESS IN THE DESIGN OF BROADCAST RECEIVERS.—A. Clausing. (*Zeitschr. V.D.I.*, 24th March, 1934, Vol. 78, No. 12, pp. 375–378.)

ELEVEN YEARS OF RADIO RECEIVER MANUFACTURE [and the "Mortality Figures" for Receiver Manufacturers].—(*Electronics*, March, 1934, pp. 72–73 and Front Cover.)

A NEW RECEIVING SYSTEM ["Single-Span Tuning," avoiding Ganged-Circuit Disadvantages while covering 200–2 000 Metres without Switching].—W. T. Cocking. (*Wireless World*, 23rd March, 1934, Vol. 34, pp. 196–197.)

A superheterodyne system with the exceptionally high intermediate frequency of 1.6 Mc/s. Tuning is on the oscillator only; no signal-frequency tuned stages are used, but a fixed aerial coupling system is employed passing all frequencies between 1 500 and 150 kc/s and rejecting all others. Further details are given in the issues for 30th March and 6th April, pp. 214–216 and 232–234.

THE WIRELESS WORLD SINGLE-SPAN RECEIVER [for A.C. Mains].—W. T. Cocking. (*Wireless World*, 13th, 20th and 27th April, 1934, Vol. 34, pp. 250–254, 268–272, and 287–290.) Based on the principles referred to in preceding abstract.

QUIET, AMPLIFIED, AND DELAYED A.V.C. WITH A SINGLE VALVE.—(*Wireless World*, 27th April, 1934, Vol. 34, pp. 296–297.)

A technical description of a new triple-diode-triode valve which enables full A.V.C. to be obtained without the use of an additional valve.

THE TELEFUNKEN "VIKING" BROADCAST RECEIVER [for D.C. or A.C. Mains, with Short-Wave Range]. — Telefunken. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 129–132.)

"DIALLING" REMOTE CONTROL [as in Automatic Telephony] OF RECEIVER TUNING.—Koch and Sterzel Company. (German Pat. 573 987: *Funktech. Monatshefte*, March, 1934, No. 3, p. 127.)

MODERN RADIO COMPONENTS [for Broadcast Receivers].—(*Rad. Engineering*, March, 1934, Vol. 14, No. 3, pp. 5–9.)

KRITISCHES ZUR LAUTSTÄRKEREGULIERUNG (A Critical Examination of Volume Control).—J. Mertig. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 111–113.)

One conclusion reached is that the best curve is given by an ohmic control whose characteristic corresponds to a total attenuation of 4–5 nepers; an angle of 90° should thus give an attenuation of 1–1.5 nepers. The common practice in the industry of using an attenuation of 10–12 nepers, with a 90° attenuation around 2.9 nepers, may be satisfactory for reducing the local stations but is very bad for distant reception: the characteristic of a good volume control should not be determined by the maximum signal strength reaching the receiver input. A simple solution is the "local/distant" switch device; another is the double potentiometer, one half of which regulates the r.f. sensitivity while the other half, independently adjusted, acts as a volume control in the l.f. stages. "The medium-class set [of 3 or 4 valves] of the future will possess, as well as a volume control, a sensitivity control in the form of an attenuation network (with step-by-step switch) or of a potentiometer."

TONE CONTROL USING A HIGH-NOTE AND A LOW-NOTE CIRCUIT CONNECTED IN PARALLEL THROUGH A DAMPING RESISTANCE WITH ADJUSTABLE TAPPING POINT. — Philips Company: Dijksterhuis. (German Pat. 585 999, pub. 14.10.1933: *Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 106.)

BRIDGE NETWORKS IN WIRELESS RECEIVERS [Anti-Retroaction Circuits: Duo-Diode Triode and S.G. Pentode Circuits: Duo-Phase and Paraphase Circuits: Tone-Control Circuits: etc.].—H. R. Cantelo. (*World-Radio*, 16th March, 1934, Vol. 18, No. 451, pp. 390–391: Corrections, *ibid.*, 23rd March, p. 425.)

STABILITY OF RESISTANCE-COUPLED AMPLIFIERS [Retroaction due to Common Anode Supply: Theory giving Conditions of Stability: Graphs for Calculation of Decoupling Circuits].—W. Baggally. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, pp. 179–182.)

DECOUPLING EFFICIENCY.—B. J. Stevens : Kinross : Barclay. (*Wireless Engineer*, March, 1934, Vol. 11, No. 126, p. 129.) Continuation of the discussion referred to in February Abstracts, p. 91, l-h column. For Kinross's reply see *ibid.*, April, p. 195.

DEVICE FOR PREVENTING OSCILLATION IN MULTI-STAGE R.F. AMPLIFIERS [Heating-Current Leads bridged by R.F. Shorting Condenser, with Low-Resistance Choke in One Lead between Each Stage].—S. Loewe. (German Pat. 587 501, pub. 9.11.1933 : *Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 105 and Fig. 1, p. 106.)

PREVENTION OF DISTORTION-PRODUCING ANODE RECTIFICATION BY USE OF MULTI-GRID VALVE AS LEAKY-GRID DETECTOR.—Philips Company : Posthumus. (German Pat. 588 218, pub. 14.11.1933 : *Hockf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 106.)

THE EFFECT OF SCREENING CANS ON THE EFFECTIVE INDUCTANCE AND RESISTANCE OF COILS [with Simple Formulae for Calculation of Essential Characteristics].—G.W.O.H. (*Wireless Engineer*, March, 1934, Vol. 11, No. 126, pp. 115–117.) Editorial based on Kaden's work (1933 Abstracts, pp. 576–577).

DIE DARSTELLUNG VON RESONANZKURVEN DURCH DEN KATHODENSTRAHL - OSZILLOGRAPHEN (The Recording of [Receiver] Resonance Curves by the Cathode-Ray Oscillograph [with Details of Equipment, including Rotating Transmitting Condenser combined with Rotating Time-Base Potentiometer : Methods of Cutting-Out the Return Half of the Condenser Variation : a " Trip " Condenser Device using a Compression Condenser driven by Rotating Cam]).—R. Schadow. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 105–107.) *Cf.* January Abstracts, pp. 46–47.

WORK ON THE TESTING OF BROADCAST RECEIVERS. —Heinrich-Hertz Society. (*See* abstract under " Miscellaneous," section 6.)

SUPERHETERODYNE CIRCUIT WITH BEAT FREQUENCY HIGHER THAN SIGNAL FREQUENCY : TWO-GRID VALVE IN DYNATRON CIRCUIT AS MIXING VALVE.—R.C.A. (German Pat. 583 930, pub. 12.9.1933 : *Hochf:tech. u. Elek:akus.*, February, 1934, Vol. 43, No. 2, p. 70.)

ON THE REASONS FOR THE PARTIALLY BAD RECEPTION OF HITLER'S SPEECH OF 21.III.1934. (*Die Sendung*, 6th April, 1934, Vol. 11, No. 15, p. 289.)

ANODE-BEND DETECTOR VALVE SWITCHED (WITH CHANGED GRID BIAS) TO WORK AS AMPLIFIER FOR GRAMOPHONE REPRODUCTION.—A.E.G. (German Pat. 587 304, pub. 2.11.1933.)

DIE RÜCKKOPPLUNG (Retroaction [and Its Failure with Anode-Bend Detection]).—A. Ruhrmann. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 87–88.)

WHAT IS REACTION ? [Desirability of Definite Replacement of Term by " Retroaction " or " Regeneration "].—F. Pinto Basto. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 193.)

WHAT IS DEMODULATION ? [Alternative Uses of the Word].—C. B. Fisher ; G.W.O.H. (*Wireless Engineer*, March, 1934, Vol. 11, No. 126, p. 128.) Continuation of the argument referred to in March Abstracts, p. 152, r-h column.

AERIALS AND AERIAL SYSTEMS

ON THE CHARACTERISTICS OF THE ELECTROMAGNETIC FIELD NEAR THE TUNED STRAIGHT ANTENNA [and Their Representation by " Isovalent " and " Isoclinic " Lines].—H. Iwakata. (*Journ. I.E.E. Japan*, February, 1934, Vol. 54 [No. 2], No. 547, pp. 121–130 : English summary pp. 13–15.)

Tsutsumi, in his work on photostatics, has proposed a new indicative method on calculating a two-dimensional electric field by using the two types of line mentioned : the former is the locus of the points of equal amplitude, the latter the locus of the points of equal direction. The present writer applies the method to the qualitative and quantitative analysis of the electromagnetic field near a half-wave aerial. Among the results obtained, " the distribution of electromagnetic field near the wire is not of pure sine wave [form] even if the current on the wire is assumed to be sinusoidal, and the wavelength obtained from the distance between two adjacent nodal points is a little larger than the natural wavelength of the oscillation current on the wire : this means that the apparent velocity of the electromagnetic wave near the wire is larger than the light velocity. It is recognised that this effect appears more markedly with increase in tuning frequency of the exciting current, and also in the middle part than at the end of the wire."

REFLECTOR FOR ULTRA-SHORT WAVES [Transmitting Dipole at Focus of Parabolic Mirror : Forward Dispersion Radiation reduced by Secondary Radiator in Shadow of First Dipole : Beam Power more than Doubled].—Naamlooze Venootschap Machinerieen en Apparaten Fabrieken. (French Pat. 757 228, pub. 22.12.1933 : *Rev. Gén. de l'Élec.*, 31st March, 1934, Vol. 35, No. 13, p. 102 D.)

" It is not necessary that the first dipole should be supplied by a r.f. feeder [as shown in diagram]. It may be mounted inside the transmitting valve . . ." in which case it may be necessary, in order to bring the secondary radiator close enough to give the maximum improvement of beam energy, to include the secondary radiator in the same bulb. The distance between the two radiators is a function of the wavelength, and is best determined by trial. A magnetic dipole, preferably in the form of a closed circuit, may be used instead of an electrical dipole.

AERIAL FOR MOBILE TRANSMITTERS, CONSISTING OF A SERIES OF DIPOLES EACH AT ONE JOINT OF A LAZY-TONGS DEVICE.—C. Lorenz Company. (German Pat. 584 623, pub. 22.9.1933 : *Hochf:tech. u. Elek:akus.*, February, 1934, Vol. 43, No. 2, p. 70.)

ON THE ELECTRIC WAVE LENS [Part IV of "Multi-Hertzian Oscillators": Lentoid Multi-Parabolic Reflector Combinations for Focusing Incoming 300-cm Waves].—H. Kikuchi, Y. Aoi, Y. Sudoh and K. Koshiguchi. (*Journ. I.E.E. Japan*, February, 1934, Vol. 54 [No. 2], No. 547, pp. 117–120: English summary pp. 12–13.) For the previous papers *see* February Abstracts, p. 92.

DISTURBANCE OF ELECTROMAGNETIC WAVES CAUSED BY THE EXISTENCE OF PROLATE SPHEROIDAL CONDUCTORS [Part III of "Action of a Cylinder in Electromagnetic Wave Field"].—H. Kikuchi. (*Journ. I.E.E. Japan*, February, 1934, Vol. 54 [No. 2], No. 547, pp. 133–134: English summary p. 15.) For the previous parts *see* 1932 Abstracts, pp. 461–462.

MESSUNGEN IM STRAHLUNGSFELD EINER IM INNERN EINES METALLISCHEN HOHLZYLINDERS ERREGTEN LINEARANTENNE (Measurements in the Radiation Field of a Linear Antenna Excited Inside a Hollow Metallic Cylinder).—L. Bergmann and L. Krügel: Weyrich. (*Physik. Zeitschr.*, 1st March, 1934, Vol. 35, No. 5, p. 177.)

A preliminary note on measurements made in connection with calculations in a promised theorectical paper by Weyrich. The linear antenna was excited in its fundamental oscillation: for a definite wavelength, certain critical radii of the cylinder were found to give maximum values of the field strength inside the cylinder and, when the cylinder end was open, increased external radiation, greater than that from the linear antenna alone.

ELIMINATION OF PHASE SHIFTS BETWEEN THE CURRENTS IN TWO ANTENNAS [due to Variation of One Antenna in Capacity or Resistance: as in Adcock-Aerial Radio-Range Beacons and in Directive Broadcasting].—H. Roder. (*Proc. Inst. Rad. Eng.*, March, 1934, Vol. 22, No. 3, pp. 374–394.) Theoretical analysis confirmed by experiment.

SHORT-WAVE DIRECTIONAL AERIAL CONSISTING OF A PAIR OF CONDUCTORS (FED IN OPPOSITE PHASE) LONG COMPARED WITH WAVELENGTH, EACH MAKING ANGLE OF 50.9 $(l/\lambda)^{-0.513}$ WITH PROPAGATION DIRECTION.—R.C.A. (German Pat., 588 587, pub. 20.11.1933: *Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 106.)

MATCHED IMPEDANCE SHORT-WAVE AERIALS [Aerial and Reflector Arrays, particularly for Military Purposes].—J. L. Henderson and W. A. West. (*Roy. Signals Quarterly Journ.*, April, 1934, Vol. 2, No. 4, pp. 5–14.) Continued from the January number. Several *QST* articles are referred to.

AERIAL FOR SUBMARINES, IN INSULATING TUBE FILLED WITH COMPRESSED AIR.—Telefunken. (German Pat. 587 979, pub. 11.11.1933.)

NEUARTIGE ZIMMERANTENNA MIT ANPASSUNGS-KONDENSATOR (A New Type of Indoor Aerial with Matching Condenser [permanently attached: Capacity adjustable from 10 to 3 000 Centimetres]).—(*Funktech. Monatshefte*, March, 1934, No. 3, pp. 121–122.)

ERHÖHUNG DER LEBENSDAUER VON HOLZMASTEN (Increasing the Life of Wooden Masts).—W. Mühlhan. (*Zeitschr. V.D.I.*, 7th April, 1934, Vol. 78, No. 14, pp. 434–436.)

WOOD POLES FOR WIRELESS STATION [Increase of 100% in Efficiency on replacing Steel Towers: Worcester, U.S.A.].—(*World Power*, March, 1934, Vol. 21, No. 123, p. 119: paragraph only.)

TESTS ON MODELS OF LATTICE MASTS AND WIRELESS TOWERS.—L. Föppl. (*Elektrot. u. Masch: bau*, 25th March, 1934, Vol. 52, No. 12, p. 141: summary only.)

THE CALCULATION OF FLAT LATTICE MASTS.—E. Melan. (*E.T.Z.*, 29th March, 1934, Vol. 55, No. 13, pp. 318–319.)

MUTUAL IMPEDANCE OF GROUNDED WIRES LYING ON THE SURFACE OF THE EARTH WHEN THE CONDUCTIVITY VARIES EXPONENTIALLY WITH DEPTH.—M. C. Gray: Foster. (*Physics*, January, 1934, Vol. 5, No. 1, pp. 35–37.) Extension of Foster's work (1933 Abstracts, p. 624.)

EARTHING ELECTRODES—Difficulties of securing Low-Resistance Values.—T. C. Gilbert. (*Elec. Review*, 22nd Dec., 1933, Vol. 113, No. 2926, pp. 871–872.) *See* also February Abstracts, p. 92.

VALVES AND THERMIONICS

ZUR THEORIE DER ELEKTRONENRÖHRE MIT VERÄNDERLICHEN DURCHGRIFF LÄNGS DER SYSTEMACHSE (On the Theory of the Variable-Mu Valve with Variation along the System Axis).—J. E. Scheel and F. Marguerre. (*Archiv f. Elektrot.*, 5th April, 1934, Vol. 28, No. 4, pp. 210–233.)

The phenomena in a variable-mu valve are so complex that for the purpose of analysis it is necessary to take the various regions separately; the present paper confines itself to the most important region, that of the space charge, and deals only with co-axial electrodes. After a short treatment of a single-grid valve with constant "durchgriff," the writer considers a variable-mu valve of similar type. Neglecting the effect of the axial electrical field forces, and assuming the most practically important design in which the cross-sections are constant and do not vary along the length of the cathode (a valve with its electrodes varying in cross-section is dealt with in Appendix I), he obtains equation 3, leading to 4 and 4a, for the total emission current from the cathode. These equations, of course, involve $F(v)$, the particular discharge function chosen. Two such functions are considered, namely, $F_1(v) = B(D + v)^m$ and the

exponential function $F_1(v) = b \cdot e^{p(d+v)}$. For the first case the final equations for emission current and for the distribution of the durchgriff along the cathode are 13 and 14a; for the second case the corresponding equations are 18 and 19. In each case the notable conclusions to be deduced from the equations are discussed (subsections "b" on pp. 219–220 and 222–223 respectively).

After a short section on the co-axial screen-grid valve, the writer deals with the experimental production of a required characteristic by means of a circuit (Fig. 14) including a number of constant-mu valves with their grids all connected together and their anodes connected separately to different points of a high-tension battery. A cathode-ray oscillograph is used to observe the characteristic produced, but the measurements can also be carried out statically by means of readings of anode current and grid potential. Examples of the use of this procedure in designing variable-mu valves are given on pp. 226–228.

ÜBER DIE STEILHEIT DER RÖHRENKENNLINIEN BEI RAUMGITTERRÖHREN (The Slope of the Characteristics of Space-Charge-Grid Valves).—F. Below. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 93–94.) Based on the writer's work dealt with in 1929 Abstracts, p. 44.

DER KENNLINIEN-KOMPARATOR (The Valve-Characteristic Comparator [Cathode-Ray Oscillograph Equipment for Rapid Comparison of Valves with a Standard Valve: using Rotating Commutator, Electro-Mechanical Contact, or Noiseless Electrical Method with Full-Wave Rectifier]).—H. E. Hollmann. (*E.T.Z.*, 5th April, 1934, Vol. 55, No. 14, pp. 343–344.)

THE CALCULATION OF CLASS C AMPLIFIER AND HARMONIC GENERATOR PERFORMANCE OF SCREEN-GRID AND SIMILAR TUBES [Directly Applicable Analysis made possible by Practical Independence of Plate Current on Plate Voltage: Simple Approximation for Effect of Grid Current].—F. E. Terman and J. H. Ferns. (*Proc. Inst. Rad. Eng.*, March, 1934, Vol. 22, No. 3, pp. 359–373.)

DIRECT-READING HARMONIC SCALES [for Rapid Estimation of Harmonic Content of Valve Output Circuits with Resistive Loads: Applicable to Valve Characteristics plotted to Any Scale].—D. C. Espley and L. I. Farren. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, pp. 183–188.) For Espley's paper on the calculation of harmonic production *see* January Abstracts, p. 34, r-h column.

THE CALCULATION OF MODULATION PRODUCTS.—II [Extension to Amplitude- and Frequency-Modulated Waves].—Bartlett. (*See* under "Transmission.")

TRIODE AND THYRATRON SYMBOLS [Desirability of Distinction by indicating Presence of Positive Ions].—A. J. Maddock. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 196.)

A DIODE FOR ULTRA-HIGH-FREQUENCY OSCILLATIONS [Four-Filament Cathode arranged as Cylinder outside Small-Diameter Cylindrical Anode: Wavelengths down to 94 cm without Magnetic Field].—J. S. McPetrie. (*Wireless Engineer*, March, 1934, Vol. 11, No. 126, pp. 118–121.)

If the cathode were (as is usual) within the anode, the electrons would have a large acceleration near the cathode and would travel radially; but with the cathode surrounding the anode the velocity of emission becomes an important factor. Any component of this velocity not in a radial direction gives the electron an angular momentum about the anode which remains constant as the electron approaches the anode; as the radial distance from the latter decreases, the transverse velocity of the electron increases, and if the anode radius is sufficiently small the electron may escape capture by the anode. The field at the external cathode is weak, so that the direction of emission is more or less indiscriminate; by a suitable choice of electrode dimensions, therefore, a large proportion of the electrons should execute the required to-and-fro motion about the anode. Experiments with a first model of such a diode are described. Sahánek's description of a valve on somewhat similar lines is referred to (1933 Abstracts, p. 36); his interpretation of its behaviour is different.

RESEARCHES ON THE "BRAKE CHARACTERISTICS" OF VARIOUS VALVES [in Retarding-Field Connection].—Heinrich-Hertz Society. (*See* abstract under "Miscellaneous," section 4.)

TRIPLE-PURPOSE DUAL TUBES IN "5 AND 10" [Ultra-Short-Wave] PORTABLES.—J. L. Reinartz. (*QST*, March, 1934, Vol. 18, No. 3, pp. 31–32.)

VACUUM TUBE CHARACTERISTICS IN RELATION TO THE SELECTION OF COINCIDENT PULSES FROM COSMIC RAY COUNTERS.—Fussell and Johnson. (*See* under "Atmospherics and Atmospheric Electricity.")

THE TREND OF MODERN [Receiving] VALVE DESIGN.—A. R. Mullard. (*Roy. Signals Quarterly Journ.*, April, 1934, Vol. 2, No. 4, pp. 25–30.)

TELEFUNKEN TRANSMITTING, POWER AMPLIFIER AND RECTIFIER VALVES: II.—POWER AMPLIFIER VALVES.—W. E. Kühle and D. Prinz. (*Telefunken-Zeit.*, March, 1934, Vol. 15, No. 66, pp. 26–31.)

"ELEKTRONEN-RÖHREN," Vol. 2. RECTIFIERS. 4TH EDITION [Book Review].—H. Barkhausen. (*Hochf:tech. u. Elek:akus.*, February, 1934, Vol. 43, No. 2, p. 71.)

THE REQUIREMENTS OF SOME GLASSES USED IN THE ELECTRICAL INDUSTRIES [for Valves, Discharge Tubes, etc.].—E. Seddon. (*Glass Review*, Sheffield, April, 1934, Vol. 10, No. 4, pp. 56–61.) Part of a series.

COLLOIDAL GRAPHITE IN ELECTRONICS FIELD.—R. Szymanowitz. (*Electronics*, March, 1934, p. 87.)

As a coating on glass walls, to conduct stray charges to earth; on grids, to discourage secondary

emission ; as electrodes for selenium cells, avoiding the trouble caused by formation of selenides if metal is used ; in alkali photocells ; as fixed and variable resistances ; as cement for carbon filaments; as getter.

STÖRGERÄUSCHE BEI INDIREKT GEHEIZTEN RÖHREN (Noise with Indirectly Heated Valves [due to Electrical and Magnetic Fields of Heating System and to Ohmic and Capacitive Resistance between Heating System and Grid and Anode ; Methods of Suppression]).—T. von Hauteville. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 89–91.)

THE SPONTANEOUS BACKGROUND NOISE IN AMPLIFIERS DUE TO THERMAL AGITATION AND SHOT EFFECTS.—Moullin and Ellis. (*See* under " Reception.")

ZUR BEDEUTUNG VON WÄRME- UND SCHROTEFFEKT (The Relative Importance of the Thermal Agitation and Shot Effects).—H. Roder : Hässler. (*Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 88.)

Hässler (1933 Abstracts, p. 619) concludes that the thermal agitation effect can be completely neglected in comparison with the shot effect. Roder writes to point out that under certain conditions the exact opposite is the case, and that these conditions occur in most broadcast receivers, since these usually have a highly amplifying s.g. valve in the first r.f. stage. In oscillators, on the other hand, the two effects have, as it were, equal chances, and the much greater shot effect voltages render the other effect negligible, as Hässler found.

THE SHOT EFFECT AND ELECTRICAL BREAKDOWN IN INSULATORS.—Haworth and Bozorth. (*See* under " Subsidiary Apparatus and Materials," p. 335.)

CONTRIBUTION TO THE ELECTRON OPTICS OF CATHODE-RAY TUBES [and the Investigation of the Process of Formation of Oxide Cathodes].—von Ardenne. (*See* under " Subsidiary Apparatus and Materials," p. 336.)

WORKING CATHODE OF OXIDE DISC ON METAL FOIL BOMBARDED FROM BELOW BY AUXILIARY ELECTRON SOURCE AND EXCITED TO SECONDARY EMISSION.—S. Loewe. (German Pat. 587 113, pub. 30.10.1933 : *Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 107 and Fig. 11 on p. 106.)

THE DISTRIBUTION OF INITIAL VELOCITIES [in Accordance with Maxwell's Law] OF POSITIVE IONS FROM TUNGSTEN.—G. J. Mueller. (*Phys. Review*, 1st March, 1934, Series 2, Vol. 45, No. 5, pp. 314–319.)

THE THERMAL IONISATION OF SODIUM VAPOUR AT A GLOWING TUNGSTEN SURFACE.—N. D. Morgulis. (*Physik. Zeitschr. der Sowietunion*, No. 2, Vol. 5, 1934, pp. 221–240.)

RESISTANCE AND RADIATION OF TUNGSTEN AS A FUNCTION OF TEMPERATURE.—W. E. Forsythe and E. M. Watson. (*Journ. Opt. Soc. Am.*, April, 1934, Vol. 24, No. 4, pp. 114–118.)

DIRECTIONAL WIRELESS

THE POLARISATION OF SKY WAVES IN THE SOUTHERN HEMISPHERE [and the Influence of the Earth's Field on Night Errors].—Green. (*See* under " Propagation of Waves".)

A DIRECT-READING DIRECTION FINDER. — R. Braillard and J. Marique. (German Pat. 586 460, pub. 21.10.1933 : *Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 107.) *See* also 1931 Abstracts, pp. 618–619.

D.F. FOR SUBMARINES : TELESCOPIC AERIAL SYSTEM FOR USE AWASH OR BELOW.—Marconi Company. (*Electrician*, 13th April, 1934, Vol. 112, No. 2915, p. 511.)

ALTITUDE METER FOR AIRCRAFT, DEPENDING ON BRIDGE-CIRCUIT DETERMINATION OF ADMITTANCE CHANGES BETWEEN TWO SURFACES, DUE TO VARYING HEIGHT ABOVE EARTH : MEASURING WAVELENGTH LONGER THAN 2 000 METRES.—Siemens & Halske. (German Pat. 586 087, pub. 18.10.1933 : *Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 106.)

STUDY OF THE MAGNETIC FIELD PRODUCED BY A LOW-FREQUENCY CURRENT CIRCULATING IN A CONDUCTOR IN THE PRESENCE OF THE GROUND.—C. Bourgonnier. (*Bull. de la Soc. franç. des Élec.*, March, 1934, Vol. 4, Series 5, No. 39, pp. 261–296.)

ACOUSTICS AND AUDIO-FREQUENCIES

METODO SEMPLICE PER LO STUDIO DI APPARECCHI DESTINATI ALLA RIPRODUZIONE ELETTRICA DEI SUONI (A Simple Method for the Study of Apparatus for the Electrical Reproduction of Sound [Curve-Tracing Combination of Rotating Mirror and Mirror Galvanometer, the latter fed by Thermopile heated by Pick-Up Output : and an Automatic Apparatus for Interpreting the Resulting Curves (taking Square Roots of Ordinates) : Applicable also to Amplifiers and Loudspeakers]).—N. Mortara. (*La Ricerca Scient.*, 28th Feb. 1934, 5th Year, Vol. 1, No. 4, pp. 193–199.)

INVESTIGATION OF THE SOUND TRACK OF A GRAMOPHONE DISC BY MEANS OF A PICK-UP EMBODYING THE AIR-JET BOLOMETER.—Sell. (*See* reference under " Subsidiary Apparatus and Materials," p. 337.)

LA FABRICATION DES DISQUES DE PHONOGRAPHE (The Manufacture of Gramophone Discs).—G. Worms. (*Génie Civil*, 17th March, 1934, Vol. 104, No. 11, pp. 243–247.)

SUPERSONIC MEASUREMENT OF THE DIRECTIONAL CHARACTERISTICS OF HORNS.—S. Goldman. (*Journ. Acous. Soc. Am.*, January, 1934, Vol. 5, No. 3, pp. 181–195.)

THE GRAMOPHONE HORN [Theoretical Paper Illustrating Problems of General Linear Propagation by Analysis of Conditions Necessary for Effective Resonance].—J. Larmor. (*Proc. Camb. Phil. Soc.*, 30th April, 1934, Vol. 30, Pt. 2, pp. 242–248.)

DIRECTIONAL SOUND RECORDING BY HIGH-NOTE MICROPHONE AT CONCENTRATION POINT OF CONCAVE COLLECTING SURFACE AND LOW-NOTE MICROPHONE IN WALL OF LATTER.—Universum-Film Company. (German Pat. 586 457, pub. 21.10.1933: *Hochf:tech u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 107.)

PHOTOGRAPHIC RECORDING OF SOUND FOR MOTION PICTURES [including Methods without Amplifiers, such as Cathode-Ray Tube Recording and Mirror-Band Grating passing Light to Mirror Oscillator which reflects back to Mirror Bands].—A. Sanghi. (*Electrotechnics*, Bangalore, March, 1934, No. 7, pp. 59–70.)

UNTERSUCHUNGEN ÜBER DAS GRUNDGERÄUSCH BEI DER TONFILMWIEDERGABE NACH DEM LICHTTONVERFAHREN (Investigations on Background Noise in Sound-Film Reproduction by Sound-on-Film Processes [Experimental Analysis and Conclusions as to Improvement]).—H. Grajetzky. (*E.N.T.*, February, 1934, Vol. 11, No. 2, pp. 51–60.)

DIE BEURTEILUNG DER WIEDERGABEGÜTE VON TONAUFZEICHNUNGEN IN SPROSSENSCHRIFT AUF GRUND SENSITOMETRISCHEN DATEN (Judging the Reproduction Quality of Amplitude-Process Sound-on-Film Records from Sensitometer Data).—R. Schmidt and A. Küster. (*Physik. Ber.*, 1st Feb. 1934, Vol. 15, No. 3, p. 223.)

ALLGEMEINE SCHWARZUNGSKURVEN LINEARER TRANSPARENZFUNKTIONEN (General Blackening Curves of Linear Transparency Functions [in Connection with Distortionless Sound-on-Film Work]).—W. Pistor. (*Zeitschr. f. tech. Phys.*, No. 3, Vol. 15, 1934, pp. 107–112.)

WESTERN ELECTRIC [Sound-on-Film] "NOISELESS RECORDING."—W. A. MacNair. (*Bell Lab. Record*, March, 1934, Vol. 12, No. 7, pp. 219–222.)

LOUDSPEAKERS [Improvements in: especially the Combination of "Tweeter" and Cone Speaker].—(*Rad. Engineering*, March, 1934, Vol. 14, No. 3, pp. 7–8.)

SAND-FIGURE METHOD OF INVESTIGATING THE OSCILLATION OF CONE LOUDSPEAKER DIAPHRAGMS.—Telefunken: Benecke. (German Pat. 588 165, pub. 13.11.1933: *Hochf: tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 107.) *See* also 1933 Abstracts, p. 43, r-h column.

AN ELECTROMAGNETIC MICROPHONE [depending on Variation of Energy of Electromagnetic Field with Density of Medium in which It is Generated: Voice Waves Modulate this Density].—C. Warmbach. (German Pat. 587 592, pub. 6.11.1933: *Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, p. 107.)

A SELECTIVE MICROPHONE FOR USE IN ACOUSTIC ALTIMETERS [with Resonant Diaphragm and Parabolic Horn].—L. P. Delsasso. (*Journ. Acous. Soc. Am.*, Special Programme Number, Vol 5, 1933, p. 4: summary only.)

THE CARBON MICROPHONE: AN ACCOUNT OF SOME RESEARCHES BEARING ON ITS ACTION.—F. S. Goucher. (*Journ. Franklin Inst.*, April, 1934, Vol. 217, No. 4, pp. 407–442.)

A historical account of the development of the carbon microphone is first given. An account of recent experimental work on the problem of the "loose contact" follows. Experiments and characteristic curves for the explanation of single contact action are given; the current is found to be conducted through solid carbon, with elastic deformation. A mechanical investigation of elastic contacts is described.

MICROPHONES: TELEPHONES: LOUDSPEAKERS: AN ANALYTICAL THEORY OF THE ELECTRO-ACOUSTIC TRANSFORMER [Book Reviews].—Lübcke: Geffcken and Heisig: Stenzel: Hecht and Fischer. (*Physik. Ber.*, 1st March, 1934, Vol. 15, No. 5, p. 355.)

ELECTRICAL MUSICAL INSTRUMENTS [Siemens-Bechstein-Nernst Piano, Hellertion, Trautonium, and Theremin Instrument].—R. W. P. Leonhardt. (*Elec. Review*, 9th March, 1934, Vol. 114, No. 2937, pp. 339–340.)

ON THE HERTZIAN IMPACT OF AN ELASTIC HAMMER ON A DAMPED PIANOFORTE STRING [Theoretical Investigation].—M. Ghosh. (*Phil. Mag.*, March, 1934, Series 7, Vol. 17, No. 113, pp. 521–544.)

ACOUSTIC SPECTRUM OF AN ELASTIC BODY SUBMITTED TO A SHOCK [with Application to a Stretched String].—M. Biot. (*Journ. Acous. Soc. Am.*, January, 1934, Vol. 5, No. 3, pp. 202–205.)

FACTOR FOR CONVERTING NOISE LEVELS MEASURED IN 1929/1930 NOISE SURVEY OF NEW YORK TO PROPOSED NEW REFERENCE LEVEL [Zero Level given by 1 000 c/s Note with 10^{-16} Watt/cm^2].—R. H. Galt and R. S. Tucker. (*Journ. Acous. Soc. Am.*, Special Programme Number, Vol. 5, 1933, p. 4: summary only.)

REVERBERATION MEASUREMENTS OF SOUND ABSORPTION COEFFICIENTS [Systematic Discrepancy between Results of Electrical and Aural Methods].—P. E. Sabine. (*Ibid.*, p. 4: summary only.)

MEASUREMENT OF NOISE: METHODS APPLICABLE TO THE SUSTAINED NOISES ENCOUNTERED IN ENGINEERING: IMPORTANCE OF BACKGROUND NOISE.—Churcher, King and Davies. (*Electrician*, 9th March, 1934, Vol. 112, No. 2910, p. 339.) Summary of I.E.E. paper.

"THE MEASUREMENT OF NOISE, WITH SPECIAL REFERENCE TO ENGINEERING NOISE PROBLEMS": DISCUSSION [Objective *versus* Subjective Methods of Measurement, and the Difficulty of the Double Meaning of "Decibel."]—Churcher, King and Davies. (*Electrician*, 23rd March, 1934, Vol. 112, No. 2912, p. 394: summary only.)

THE PROTECTION OF HOUSES AGAINST NOISE.—Katel. (*Génie Civil*, 31st March, 1934, Vol. 104, No. 13, pp. 299–300: summary of paper.)

ON THE "PHON" [Limits of Strict Applicability: Difference between the "Sensation Phon" and the "Threshold Phon": etc.).—R. Berger. (*Physik. Ber.*, 1st March, 1934, Vol. 15, No. 5, p. 320.) See also May Abstracts, p. 272, r-h column (three).

CURVES OF EQUAL LOUDNESS [Measurements of Threshold and Sensation Curves: Effects at High Levels similar to those of the Eye].—H. H. Heinze. (*Ibid.*, pp. 320–321.)

MEASUREMENT OF TRANSMISSION LOSS THROUGH PARTITION WALLS.—K. D. Swartzel, Jr. (*Bell Lab. Record*, April, 1934, Vol. 12, No. 8, pp. 246–248.) *See* also April Abstracts, p. 213, r-h column.

APPARATUS FOR THE OBJECTIVE MEASUREMENT AND THE ANALYSIS OF NOISES (SONOMETERS).—Castner and others: Osbon and Oplinger: Steudel. (*Ann. des. P.T.T.*, March, 1934, Vol. 23, No. 3, pp. 246–279.) Based on the papers by these authors dealt with in Abstracts, 1931, p. 563; April, p. 212; and 1933, pp. 510–511). To be continued.

MESURES DE BRUITS (Noise Measurements [particularly in Berlin]).—Bakos and Kagan. (*Ann. des P.T.T.*, February, 1934, Vol. 23, No. 2, pp. 145–166.) French version of the paper referred to in 1932 Abstracts, p. 288, l-h column.

EIN QUARZGESTEUERTER ÜBERLAGERUNGSTONGENERATOR (A Quartz-Controlled Heterodyne Note Generator [of Great Frequency Constancy: Note adjusted by detuning Anode Circuit, or changing Pressure of Crystal, in One Oscillator]).—A. Wertli. (*Helvet. Phys. Acta*, Fasc. 7, Vol. 6, 1933, p. 495.)

A NEW TYPE OF WARBLE TONE GENERATOR [with Wide Flexibility of Control and No Moving Parts: using a Triode Relaxation Oscillator].—W. H. Bliss. (*Elec. Engineering*, April, 1934, Vol. 53, No. 4, pp. 547–550.)

A TWO-PHASE AUDIO-FREQUENCY OSCILLATOR [Stable in Phase and Frequency: for supplying Phase-Shifting Transformers used in A.C. Potentiometers].—D. P. M. Millar. (*Journ. I.E.E.*, April, 1934, Vol. 74, No. 448, pp. 365–371.)

BEAT FREQUENCY OSCILLATOR [Instability due to Temperature Variation of Mica Condensers: Wave Form of Gramophone Scratch and Valve Hiss].—W. W. Lindsay, Jr.: A. W. Stewart: Morgan. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 195.) Continuation of discussion referred to in April Abstracts, p. 213, l-h column.

THE TECHNIQUE OF SPUTTERING SENSITIVE THERMOCOUPLES [suitable for measuring the Adiabatic Heat in a Sound Field up to 5 000 c/s].—L. Harris and E. A. Johnson. (*Review Scient. Instr.*, April, 1934, Vol. 5, No. 4, pp. 153–158.)

THE POWER OF OUTPUT VALVES IN AMPLIFIERS AND ITS PRACTICAL IMPORTANCE [Argument on Best Method of Specification and on the Output Powers required for Sound-Film Theatres].—M. Reithoffer: Leithäuser. (*E.T.Z.*, 5th April, 1934, Vol. 55, No. 14, pp. 357–358.)

On Leithäuser's paper dealt with in 1933 Abstracts, p. 45. The latter writer defends his views, and points out that the 200-watts undistorted output, suggested by Reithoffer as usual in very large theatres, would cover an area of some square kilometres.

THE PRACTICAL CALCULATION OF A POWER AMPLIFIER [Undistorted Speech Output $1\frac{3}{4}$ Watt] FOR D.C. MAINS.—W. Daudt. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 95–98.).

DISCUSSIONS ON "STABILISED FEED-BACK AMPLIFIERS."—H. S. Black. (*Elec. Engineering*, March and April, 1934, Vol. 53, Nos. 3 and 4, pp. 461–462 and 590.) *See* May Abstracts, p. 272, l-h column.

REVERBERATION TIME AND ABSORPTION MEASUREMENTS WITH THE HIGH-SPEED LEVEL RECORDER.—E. H. Bedell and K. D. Swartzel, Jr. (*Journ. Acous. Soc. Am.*, Special Programme Number, Vol. 5, 1933, p. 4: summary only.)

EFFECT OF DISTRIBUTION AND LOCATION OF ACOUSTICAL MATERIAL UPON ITS SOUND ABSORPTION.—V. L. Chrisler. (*Ibid.*, p. 4: summary only.)

RECENT DEVELOPMENTS IN ARCHITECTURAL ACOUSTICS [Illustrated from Planetarium and Music Hall of Radio City].—P. E. Sabine. (*Journ. Franklin Inst.*, April, 1934, Vol. 217, No. 4, pp. 443–458.)

RECENT DEVELOPMENTS IN ARCHITECTURAL ACOUSTICS.—V. O. Knudsen. (*Reviews of Modern Physics*, January, 1934, Vol. 6, No. 1, pp. 1–22.)

ACOUSTICAL PERSPECTIVE [and the Illusion of Distance from Microphone caused by Controlling the Reverberation Heard, suggesting a New Constant, the "Liveness Constant."].—F. A. Firestone. (*Proc. Inst. Rad. Eng.*, March, 1934, Vol. 22, No. 3, p. 289: summary only.)

AUDITORY PERSPECTIVE [including Control Methods of the Philadelphia/Washington Demonstration].—E. H. Bedell. (*Rad. Engineering*, March, 1934, Vol. 14, No. 3, pp. 16–17.) *See* 1933 Abstracts, p. 452, r-h column.

AUDITORY PERSPECTIVE: PAPERS ON WORK IN CONNECTION WITH THE PHILADELPHIA/WASHINGTON DEMONSTRATION.—W. B. Snow: E. H. Bedell: A. L. Thuras: R. E. Crane. (*Bell Lab. Record*, March, 1934, Vol. 12, No. 7, pp. 194–213.) For other papers *see* March Abstracts, p. 155, and elsewhere.

VISUAL INDICATOR FOR ORCHESTRAL LEVELS [used by Stokowski in conducting Broadcast Concerts].—(*Electronics*, March, 1934, p. 82.)

THE NEW BROADCASTING LONG-DISTANCE CIRCUIT SYSTEM "VERST 34."—L. Fenyö and K. Bär. (*T.F.T.*, February, 1934, Vol. 23, No. 2, pp. 29–33.)

RESEARCHES ON THE CONSTRUCTION OF HIGH-FREQUENCY CIRCUITS (100 000 c/s) FOR TELEPHONY AND TELEVISION.—Jannès and Marzin. (*See* under "Phototelegraphy and Television").

WIDE-BAND OPEN-WIRE [Broadcasting] PROGRAMME SYSTEM [for Frequency Range about 50–8 000 c/s, Volume Range about 40 db, Negligible Non-Linear and Phase Distortion]. —H. S. Hamilton. (*Elec. Engineering*, April, 1934, Vol. 53, No. 4, pp. 550–562.) *See* also Leconte, May Abstracts, p. 273, l-h column.

LINE FILTER FOR [Broadcasting] PROGRAMME SYSTEM [to separate Programme and Carrier Telephony Currents].—A. W. Clement. (*Ibid.*, pp. 562–566.) *See* also May Abstracts, p. 273, l-h column.

FILTRATION OF ELASTIC WAVES IN SOLID RODS [Low-Pass and High-Pass Filter Actions of Rods with Equally-Spaced Heavy Discs or Side Rods].—R. B. Lindsay. (*Journ. Acous. Soc. Am.*, January, 1934, Vol. 5, No. 3, pp. 196–201.) Extension of the work referred to in 1933 Abstracts, p. 219, l-h col.

ACOUSTIC FILTRATION IN NON-HOMOGENEOUS MEDIA.—Lindsay, Lewis and Albright. (*Ibid.*, pp. 202–205.)

RESISTANCE CHANGES OF NICKEL, IRON AND BISMUTH IN AUDIO-FREQUENCY ALTERNATING MAGNETIC FIELDS.—J. Müller. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 5/6, pp. 277–294.)

HEARING SOUNDS OF DIFFERENT PITCH [Evidence of a Dual Mechanism: "Telephone" Theory for Low Notes, "Resonance" Theory for High].—Clifford Pearce. (*Science*, 13th April, 1934, Vol. 79, No. 2050, pp. 10–12.)

A NEW PROPERTY OF THE EAR? [Pitch of Very Low Notes raised, of Higher Notes lowered, by about Half a Tone, on Approaching the Ear to Source of Sound].—J. J. H. Vrijdaghs. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, pp. 196–197.)

THE HELMHOLTZ RESONANCE THEORY OF HEARING. —C. S. Hallpike and A. F. Rawdon Smith. (*Nature*, 21st April, 1934, Vol. 133, p. 614.) A note of an experiment on a cat giving direct evidence that the vibrating elements of the cochlea are differentially tuned for frequency.

THE INFLUENCE OF PHASE ON TONE QUALITY AND LOUDNESS: THE INTERFERENCE OF SUBJECTIVE HARMONICS.—E. K. Chapin and F. A. Firestone. (*Journ. Acous. Soc. Am.*, January, 1934, Vol. 5, No. 3, pp. 173–180.)

ELECTRICAL EQUIPMENT FOR IMITATING THE HUMAN VOICE.—Heinrich-Hertz Society. (*See* abstract under "Miscellaneous," section 10.)

A NEW EXPERIMENTAL PHONETICS LABORATORY [at Armstrong College, Newcastle—Description of Building, Equipment and Work]. —(*Nature*, 28th April, 1934, Vol. 133, pp. 655–656.)

"TECHNISCHE AKUSTIK" [Vol. XVII of the "Handbook of Experimental Physics": Book Review].—(*Review Scient. Instr.*, April, 1934, Vol. 5, No. 4, pp. 170–171.)

NOTE ON THE VELOCITY OF SOUND [Heat Exchange prevented by Too Low a Frequency, not Too High (as always taught)].—E. U. Condon. (*Physik. Ber.*, 15th Feb. 1934, Vol. 15, No. 4, p. 242.)

SUMMARIES OF PAPERS REFERRING TO ARTIFICIAL HEARING AIDS, SOUND RECEIVED THROUGH THE SKIN, PHYSICAL DEFINITION OF "GOOD VOICE QUALITY" IN THE MALE VOICE, ETC. —(*Journ. Acous. Soc. Am.*, Special Programme Number, Vol. 5, 1933, pp. 4–8.)

THE OPTICAL DEMONSTRATION OF THE HARMONICS AND MODE OF OSCILLATION OF A PIEZO-ELECTRIC QUARTZ [in a Liquid] BY THE METHOD OF DEBYE AND SEARS, AND ITS APPLICATION TO THE MEASUREMENT OF ELECTRICAL WAVELENGTHS.—Bergmann. (*See* under "Measurements and Standards.")

RENDERING SUPERSONIC WAVES IN FLUIDS VISIBLE. —H. R. Asbach, C. Bachem and E. Hiedemann. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 5/6, pp. 395–398.) For previous work *see* May Abstracts, p. 273.

INTENSITY MEASUREMENTS CONTRIBUTING TO THE EXPLANATION OF THE DE-POLYMERISING ACTION OF SUPERSONIC WAVES.—A. Szalay. (*Physik. Zeitschr.*, 1st April, 1934, Vol. 35, No. 7, pp. 293–296.)

PHOTOTELEGRAPHY AND TELEVISION

THE STIXOGRAPH AND SCOPHONY. II and III.— G. W. Walton. (*Television*, April and May, 1934, Vol. 7, Nos. 74 and 75, pp. 149–152, 180 and 182, and 199–202.) Continuation of the paper dealt with in May Abstracts, pp. 273–274.

PICTURE-WITH-SOUND TRANSMISSION [using Scophony Scanning for both Sound and Vision]. —G. W. Walton. (British Pat. 403 397: *Television*, April, 1934, Vol. 7, No. 74, p. 165.) Development of the patent referred to in May Abstracts, p. 274.

THE TELEVISION BROADCASTS: WHAT THE B.B.C. SHOULD DO: SOME WELL-KNOWN AUTHORITIES OFFER THEIR OPINIONS ON POLICY.— (*Television*, May, 1934, Vol. 7, No. 75, pp. 188–191 and 228, 230.)

HOW THE B.B.C. TRANSMITS TELEVISION: DESCRIPTION OF THE NEW STUDIO AND APPARATUS AT NO. 16, PORTLAND PLACE.—(*World-Radio*, 23rd March, 1934, Vol. 18, No. 452, pp. 423–425.)

THE B.B.C.'S NEW TELEVISION STUDIO [and Its Equipment].—D. C. Birkinshaw. (*Television*, April, 1934, Vol. 7, No. 74, pp. 140–144.)

FERNSEHEN MIT KATHODENSTRAHLRÖHREN (Television with Cathode-Ray Tubes).—V. K. Zworykin. (*Hochf:tech. u. Elek:akus.*, April, 1934, Vol. 43, No. 4, pp. 109–121.) German version of the paper dealt with in Abstracts, February, p. 101, l-h column: *see* also several references, March, p. 158.

DIE FERNSEHVERSUCHE DES REICHSPOSTZENTRALAMTS (The Television Tests of the German Post Office).—Bannetz. (*E.N.T.*, February, 1934, Vol. 11, No. 2, pp. 73–74.)

RECEPTION OF GERMAN P.O. TELEVISION ON ULTRA-SHORT WAVES.—Heinrich-Hertz Society. (*See* abstract under "Miscellaneous," section 5.)

INTENSITY CONTROL IN CATHODE-RAY TUBES: DOUBLE SYSTEM OF ELECTROSTATIC LENS, WHOSE FOCAL LENGTH IS MODULATED, AND MAGNETIC CONCENTRATING COIL.—Telefunken. (German Pat. 585 599, pub. 9.10.1933: *Hochf:tech. u. Elek:akus.*, February, 1934, Vol. 43, No. 2, p. 70.)

"DIE KATHODENSTRAHLRÖHRE UND IHRE ANWENDUNG IN DER SCHWACHSTROMTECHNIK" (The Cathode-Ray Tube and Its Use in Communication Engineering [Book Review]).—M. von Ardenne. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 198.)

A NEW SYSTEM OF TELEVISION USING POLARISED LIGHT.—P. Contant. (*Rev. Gén. de l'Élec.*, 24th March, 1934, Vol. 35, No. 12, p. 95–96 D.)

Summary only. "The field of exploration is constituted by the cross section of a beam of n elementary polarised rays, of the same intensity and wavelength but having different azimuths for their respective vibrations." The writer makes use of three phenomena: "the rotatory polarisation of quartz, enabling him to obtain the required field of exploration; the conical refraction of certain bi-axial crystals, which gives him the selecting organ; and finally the electrical rotation of the plane of polarisation, which ensures the progression of the analysis and the necessary synchronisation without the need of mechanically moving parts."

HIGH-DEFINITION TELEVISION.—Baird Company. (*Wireless World*, 30th March, 1934, Vol. 34, p. 219.) Details of a special demonstration by the Baird Company of "Quality" radio-television on ultra-short waves. The wavelengths used were 6 metres for vision and 6.25 metres for sound. 180-line scanning, with 25 frames per second, was employed.

HIGH OR LOW DEFINITION? [and the Difference between "Flicker" in the Cinema and in Television: Modern Practice in Cinema Technique to project Each Frame Two or Three Times: Synchronisation at Berlin Exhibition: etc.].—O. S. Puckle. (*Television*, May, 1934, Vol. 7, No. 75, pp. 215 and 216.) Continuing the argument mentioned in May Abstracts, p. 275, l-h column.

SOME COMMENTS ON THE IVES THEORY OF FLICKER.—P. W. Cobb. (*Journ. Opt. Soc. Am.*, March, 1934, Vol. 24, No. 3, pp. 91–98.)

THE DEPENDENCE OF FLICKER ON THE DARK/LIGHT RATIO OF THE STIMULUS CYCLE.—P. W. Cobb. (*Journ. Opt. Soc. Am.*, April, 1934, Vol. 24, No. 4, pp. 107–113.)

ACUITY OF VISION AS A FUNCTION OF BRIGHTNESS.—M. Kruyswijk and C. Zwikker. (*Physica*, February, 1934, Vol. 1, No. 4, pp. 225–234: in English.)

RECOGNISING DEFECTS IN TELEVISION IMAGES.—R. Desmond. (*Television*, May, 1934, Vol. 7, No. 75, pp. 192–194.)

PHASE DISTORTION: WHAT IT IS—AND WHAT IT DOES.—R. Desmond. (*Television*, April, 1934, Vol. 7, No. 74, pp. 157–158 and 160.)

"It is unfortunate that after several years of radiation of television signals, phase distortion is present in the signal and that, in consequence, many of us have never seen a picture free from this defect."

PUZZLING PARADOXES IN TELEVISION.—J. C. Wilson. (*Television*, April and May, 1934, Vol. 7, Nos. 74 and 75, pp. 163–164 and 205–206.)

DER HEUTIGE STAND DER FERNSEH-ÜBERTRAGUNG (The Present Position of Television).—F. Schröter. (*Telefunken-Zeit.*, March, 1934, Vol. 15, No. 66, pp. 5–18.)

This first part of a survey begins by recalling Aigner's theoretical treatment (8 years ago) of the problem of television and the idea of a discrete raster element which, though existing only in theory, is of great use for defining the fineness of the scanning analysis. On applying this treatment to modern ultra-short-wave transmission under practical conditions it is seen that the difficulties (*e.g.*, as to decrement) indicated by the theory are greatly diminished, so that the full fineness of definition which may be expected from a line-number around 200 can be attained. The number of elements ρ corresponding to this number of lines (square format) is around 40 000, and if n (the framing frequency) is 25 per sec. the highest frequency required, given by $\frac{1}{2}\rho.n$, is 5×10^5 c/s. The receiver, accommodating such a frequency band, must have very considerable damping, but with steep-slope valves (at least 6 mA/V) enough amplification per stage is attainable to keep the number of stages down to a practical figure; for with 10–20 kw radiated power available at the u.s.w. transmitter, and well-situated transmitting and receiving dipoles, signals of 1 mV or thereabouts should reach the first grid at distances of 20 to 30 km, even in much built-over districts.

Transmission over lines is a problem still being worked upon with hopeful results. In mentioning this, the writer raises the question of the difficulties likely to arise, in u.s.w. television, in separating different channels: difficulties increased by the high physiological amplitude-sensitivity of the eye compared with the ear. The transmitting aerials will have to be situated so that the different waves suffer similar attenuations, and the synchronising

signals will have to coincide, otherwise one transmission will upset the synchronisation of the other.

RESEARCHES ON THE CONSTRUCTION OF HIGH-FREQUENCY CIRCUITS (100 000 c/s) FOR TELEPHONY AND TELEVISION [Twin-Core and Concentric Cables for Linking New French Broadcasting Stations with Their Corresponding Cities].—H. Jannès and P. Marzin. (*Bull. de la Soc. franç. des Élec.*, February, 1934, Vol. 4, Series 5, No. 38, pp. 193–218.) *See* next reference.

TELEVISION CABLES [Paris-Pontoise Measurements on Twin-Core and Concentric Cables, at 100 000 Cycles/Second]. — G. W. O. H. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, pp. 173–174.) Editorial on the paper referred to above.

NEW DETERMINATION OF THE KERR CONSTANT OF NITRO-BENZOL [$B = 3.01 \times 10^{-5}$ for $\lambda = 5\,461$ A.U. at 20° C.].—A. Narath. (*Physik. Ber.*, 1st April, 1934, Vol. 15, No. 7, pp. 530–531.)

HIGHLY REFLECTING FILMS OF ZINC SULPHIDE [transmitting 57%, reflecting 41% and absorbing 2%].—A. H. Pfund. (*Journ. Opt. Soc. Am.*, April, 1934, Vol. 24, No. 4, pp. 99–102.)

A 35-μA PER LUMEN VACUUM PHOTOCELL IN HEADLAMP BULB.—G. E. C. (*Electronics*, March, 1934, p. 86.) *See* also February Abstracts, p. 102, l-h column.

ÜBER ZUSAMMENGESETZTE PHOTO-KATHODEN (Composite Photo-Cathodes).—R. Fleischer and P. Gorlich. (*Physik. Zeitschr.*, 1st April, 1934, Vol. 35, No. 7, pp. 289–292.)

When a layer of caesium oxide, permeated with caesium atoms, is covered with an extremely thin layer of an inactive metal, the photoelectric sensitivity is greatly increased. Measurements of the distribution of intensity in the spectrum are here described, but no definite conclusion is reached as to the reason for the action of the inactive metal.

LES CELLULES PHOTOÉLECTRIQUES À CONTACT RECTIFIANT (Barrier-Layer Photoelectric Cells [Survey with Literature and Patent References]).—G. Liandrat. (*Rev. Gén. de Élec.*, 31st March and 7th April, 1934, Vol. 35, Nos. 13 and 14, pp. 415–424 and 467–473.)

THE HALL EFFECT AND THE INTERNAL PHOTOELECTRIC EFFECT IN CUPROUS OXIDE.—I. Kikoin and M. Noskov. (*Physik. Zeitschr. der Sowietunion*, No. 3, Vol. 4, 1933, pp. 531–550 : in English.) For a preliminary communication *see* 1933 Abstracts, p. 336.

COMPENSATING CIRCUITS FOR RECTIFIER [Barrier-Layer] PHOTOELECTRIC CELLS.—N. R. Campbell. (*Journ. Scient. Instr.*, April, 1934, Vol. 11, No. 4, pp. 125–126.)

ÜBER DIE TEMPERATURABHÄNGIGKEIT DER SELENSPERRSCHICHTPHOTOZELLE (The Temperature Variation of the Selenium Barrier-Layer Photocell).—A. Mittmann. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 5/6, pp. 366–371.)

The negative temperature coefficient of the barrier-layer photoelectric effect is shown experimentally to be present in the selenium cell as well as in the copper oxide cell. The selenium cell also seems to show a fatigue phenomenon.

THE USE OF A SELENIUM BARRIER-LAYER PHOTOCELL FOR MEASURING VERY SMALL INTENSITIES [Too Slow in Action for Currents around 2×10^{-9} Ampere : Velocity dependent also on Wavelength].—H. C. Hamaker and W. F. Beezhold. (*Physica*, December, 1933, Vol. 1, No. 2, pp. 119–122 : in German.) For recent papers on the measurement of small fluxes *see* May Abstracts, p. 284 (Gambetta, r-h col.) and 276 (Boutry and Orcel).

THE PHOTOELECTRIC EFFECT PRODUCED BY X-RAYS IN COPPER-OXIDE PHOTOCELLS.—Danilenko and Tutschtkewitsch. (*Physik. Zeitschr. der Sowietunion*, No. 2, Vol. 5, 1934, pp. 359–366.)

PLANUNGSGRUNDLAGEN FÜR ZELLENVERSTÄRKER (Fundamental Design Considerations for Photocell Amplifiers).—P. Hatschek. (*Physik. Ber.*, 1st March, 1934, Vol. 15, No. 5, p. 354.)

THE BOUNDARY PHOTOELECTRIC WAVELENGTH OF TANTALUM CARBIDE [310 mμ after Degassing].—E. Engelmann and H. Teichmann. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 3/4, p. 275.)

THE SURFACE IONISATION OF POTASSIUM ON TUNGSTEN [Work Function of Tungsten determined as 4.56 e.v., Independent of Thermionic Emission].—M. J. Copley and T. E. Phipps. (*Phys. Review*, 1st March, 1934, Series 2, Vol. 45, No. 5, pp. 344–345.)

ON THE NATURE OF THE NEGATIVE PHOTOELECTRIC EFFECT IN SILVER BROMIDE [found to be Reversible].—R. G. Jensch. (*Physik. Zeitschr. der Sowietunion*, No. 1, Vol. 5, 1934, pp. 75–80.)

AN APPARATUS FOR THE TRANSFORMATION OF LIGHT OF LONG WAVELENGTH INTO LIGHT OF SHORT WAVELENGTH [Photo-Cathode on Metal Layer so Thin that Illumination on One Side causes Emission of Electrons from Other Side].—G. Holst, J. H. de Boer, M. C. Teves, and C. F. Veenemans. (*Physica*, February, 1934, Vol. 1, No. 4, pp. 297–305 : in English.)

Since the photo-cathode chosen was specially sensitive to red and infra-red light, and the fluorescent screen excited by the emitted electrons gave out blue, violet and ultra-violet light, there was a transformation from long to short wavelength. Thus a picture projected by infra-red light can be photographed with blue-sensitive plates or observed directly. Examples of photographs are given.

MEASUREMENTS AND STANDARDS

REMARQUES SUR LA CAPACITÉ PROPRE DES BOBINES (Remarks on the Self Capacity of Coils).—P. L. Cassou and J. Cayrel. (*Comptes Rendus*, 4th April, 1934, Vol. 198, No. 14, pp. 1305–1308.)

" In spite of the fine studies of Drude, Fleming,

and Seibt on solenoids, the complexity of the idea of self capacity as applied to a coil is still unperceived more often than not. The important restrictions which should be applied, from this point of view, in making use of the classic analogy between coils and aerials, are here exposed."

The writer has investigated the effective capacity of a single-layer closely-wound cylindrical coil as a function of its axial length l, exciting a number of such coils (all of the same 85 mm diameter) by means of a shunted buzzer. The natural wavelength λ_0 was measured on a very loosely coupled wavemeter and the inductance L then taken by the constant-wavelength method; the effective inductance L_e was calculated from $L_e = 2L/\pi$ and the effective capacity C_e derived from $C_e = \lambda_0^2/4\pi^2\Omega^2 L_e$. The table of results, for l ranging from 6.6 to 1 430 mm, shows that C_e *passes through a minimum for* $l = 2D$ *approximately*. The writer interprets this result as follows:—the capacity of a condenser AB, formed of two identical electrodes with equal and opposite charges, depends on (1) the *intrinsic* capacity of the electrodes A and B and (2) the *mutual* capacity resulting from the lowering of the potential of A by the negative charges of B. According to whether the electrodes A and B are very far apart or very close, so the capacity of AB will be almost entirely determined by the first or by the second factor.

Taking the case of a coil oscillating in a half wave, its two halves OP, ON, possessing at each instant equal and opposite charges, may be regarded as the electrodes of a condenser AB. The intrinsic capacity of the positive half OP ("homopolar capacity") is larger, the smaller the potential created by the positive charges at P: that is, *the longer the half coil*. On the other hand, the negative charges of the half coil ON lower the potential of the positive half OP more and more, the nearer the ends N and P (where the charge density is greatest) are to one another. The consequent increase in the capacity of the system, as the coil becomes shorter and shorter, is entitled the "heteropolar capacity." Thus $C_e = C_{\text{hom}} + C_{\text{het}}$, and when l varies from 0 to ∞, C_{hom} varies from 0 to ∞ and C_{het} from ∞ to 0. The existence of the minimum of C_e is thus explained.

Taking extreme cases of the half-wave coil, for very long coils where the capacity resembles that of a single conductor isolated in space, $C_e = C_{\text{hom}} = \text{const.} \times l$, $L_e = \text{const.} \times l$, and consequently $\lambda_0 = \text{const.} \times l$, which is the classic result; for very short coils where the capacity resembles that of a thin-plate condenser and is inversely proportional to the coil length, $C_e = C_{\text{het}} = \text{const.}/l$, $L_e = \text{const.} \times l^2$, so that $\lambda_0 = \text{const.}\sqrt{l}$.

EFFECTIVE RESISTANCES OF INDUCTANCE COILS AT RADIO FREQUENCY [Corrections].—B. B. Austin: Butterworth. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 197.) *See* April Abstracts, p. 218, l-h column.

INDUCTANCE AT HIGH FREQUENCIES AND ITS RELATION TO THE CIRCUIT EQUATIONS.—Brainerd. (*See* under "Properties of Circuits.")

MUTUAL INDUCTANCE OF TWO CIRCULAR CURRENTS IN ANY RECIPROCAL POSITION.—Hak. (*See* under "Properties of Circuits.")

INDUCTANCE OF SOLENOIDS IN CYLINDRICAL SCREEN BOXES [with Design Formulae].—W. G. Hayman. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, pp. 189–192.)

THE ALTERNATING-CURRENT INDUCTANCE OF AN IRON-CORED COIL CARRYING DIRECT CURRENT [Another Graphical Construction].—T. Tanasescu: Beatty. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 197.) For Beatty's paper *see* April Abstracts, p. 218, l-h column.

DER OPTISCHE NACHWEIS DER OBERSCHWINGUNGEN UND DER SCHWINGUNGSFORM EINES PIEZOQUARZES NACH DER METHODE VON DEBYE UND SEARS UND SEINE ANWENDUNG ZUR BESTIMMUNG ELEKTRISCHER WELLENLÄNGEN (The Optical Demonstration of the Harmonics and Modes of Oscillation of a Piezoelectric Quartz [in a Liquid] by the Method of Debye and Sears, and Its Application to the Measurement of Electrical Wavelengths).—L. Bergmann. (*Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, pp. 83–85.)

For the writer's previous papers *see* February and March Abstracts, pp. 99 (r-h col.) and 161. Particular attention is given in the present paper to the use of the method in studying the number of frequencies at which the quartz is vibrating.

ON THE DEVELOPMENT OF ELECTRICITY BY TORSION IN QUARTZ CRYSTALS [New Results: Tests on a Hollow Cylinder forming a Cylindrical Condenser: as an Oscillator: Possibility of producing Rotation].—Ny Tsi-Zé and T. Ling-Chao. (*Comptes Rendus*, 16th April, 1934, Vol. 198, No. 16, pp. 1395–1396.) For Tawil's work *see* 1932 Abstracts, pp. 48–49.

CONSTANT-FREQUENCY QUARTZ OSCILLATOR [Improved Heat Transmission from Crystal to Further Electrode by coating Surfaces with Heat-Absorbing and Radiating Materials].—Telefunken. (German Pat. 551 875: *Funktech. Monatshefte*, March, 1934, No. 3, p. 128.)

DAS SEIGNETTESALZ IM GEBIETE DER SPONTANEN ORIENTIERUNG (Rochelle Salt in the Region of Spontaneous Orientation [and the Phenomenon of Fatigue]).—I. Kurtschatow. (*Physik. Zeitschr. der Sowietunion*, No. 2, Vol. 5, 1934, pp. 200–211.)

TEMPERATURE COEFFICIENT, OSCILLATION FORM AND AMPLITUDE OF PIEZOELECTRIC OSCILLATORS.—H. Straubel. (*Physik. Zeitschr.*, 1st March, 1934, Vol. 35, No. 5, pp. 179–181.)

STABILISATION OF RADIO FREQUENCIES [Note on Radio Research Board's Work].—(*Nature*, 28th April, 1934, Vol. 133, pp. 634–635.)

ON THE STABILISATION OF FREQUENCY IN TRIODE OSCILLATORS [by Purely Electrical Methods].—Divoire and Baudoux. (*See* under "Transmission.")

SIMPLE ULTRA-SHORT-WAVE WAVEMETERS [Absorption Type: for Wavelengths down to 45 cm].—W. H. Moore. (*Journ. Franklin Inst.*, March, 1934, Vol. 217, No. 3, pp. 347–351.) On the wavemeters referred to in Abstracts, February, p. 104, r-h column: *see* also 1931, p. 612.

ÜBER UHRREGULIERUNG DURCH EIN VON MAGNETISCHEN KRÄFTEN BETRIEBENES HORIZONTALPENDEL (Clock Control by a Horizontal Pendulum driven by Magnetic Forces [Amplitude of Swing kept constant by Photocell Device: Time-Keeping unaffected by Gravity Variations]).—R. Mohr. (*Zeitschr. f. tech. Phys.*, No. 4, Vol. 15, 1934, pp. 141–143.)

PRECISION MEASUREMENT OF TIME [and a Single Photoelectrically Controlled Pendulum with Impulses imparted Electrostatically by Swinging Comb passing freely through Fixed Comb].—C. Chandrasekariah. (*Electrotechnics*, Bangalore, March, 1934, No. 7, pp. 103–107.)

THE ELECTRICAL MEASUREMENT OF SHORT TIME INTERVALS [Various Circuits for Times ranging from 0.03 Microsecond to 1 Second].—M. Steenbeck and R. Strigel. (*Archiv f. tech. Messen*, October, 1933, Vol. 3, pp. 131–132.) For previous work *see* 1933 Abstracts, p. 225.

TIME BY TELEPHONE [Paris Telephone Service giving Ten-Second Announcements by Sound-on-Film Methods].—(*Wireless World*, 13th April, 1934, Vol. 34, pp. 261–262). *See* also 1933 Abstracts, pp. 223 (r-h col.) and 576 (l-h col.).

UBER DIE MESSUNG KLEINSTER WINKELDIFFERENZEN VON SCHEINWIDERSTÄNDEN (The Measurement of Very Small Phase Angle Differences of Impedances).—A. Wirk. (*E.N.T.*, February, 1934, Vol. 11, No. 2, pp. 61–66.)

Author's summary:—"A bridge circuit is described with which it is possible to measure small angular differences of any impedances from the smallest inductances to the smallest capacities, with any desired ratio of impedance values (up to about 1 : 100), with a possible error in time-constant difference less than 10^{-10}. The impedances may have one pole earthed or may be component values of a working circuit (*e.g.*, partial capacities). The frequency range may be chosen between low note frequencies up to an angular frequency of 10^7. Within a range of 7 to 8 octaves, for a known test frequency, the required phase can be read directly as an angular difference when the bridge is balanced."

By the use of this bridge it has, for example, been possible to construct a decade resistance box for a 0–10 000 ohm range to the following requirements:—time constant, measured at the external terminals, between 10 and 4 000 ohms for any combination of decades, always below 2×10^{-9}; difference in time constants between two resistances within the decade 100–1 000 ohms, for any ratio, always below 1×10^{-9}; possible error in ohmic value less than 5×10^{-3}. The use of the bridge for the absolute measurement of dielectric loss angles and of the phases of ohmic resistances will be dealt with in a later paper.

A NEW BRIDGE FOR COMMERCIAL MEASUREMENTS OF A.C. RESISTANCES AS REGARDS MAGNITUDE AND PHASE.—M. Grützmacher. (*T.F.T.*, February, 1934, Vol. 23, No. 2, pp. 27–29.)

DISCUSSIONS ON "AN A.C. POTENTIOMETER."—S. L. Burgwin. (*Elec. Engineering*, April, 1934, Vol. 53, No. 4, pp. 624–625.) *See* March Abstracts, p. 162, r-h column.

A THERMIONIC VALVE DETECTOR FOR SUPPLY FREQUENCIES [to replace Vibration Galvanometer in A.C. Potentiometer Work].—W. S. Stuart. (*Journ. Scient. Instr.*, April, 1934, Vol. 11, No. 4, pp. 121–123.)

SOME APPLICATIONS OF AN A.C. VALVE BRIDGE [as Modulator, including a Method by which Carrier appears only on Modulation: as Detector for C. W. Signals: for Amplification and Measurement of Impulse Signals].—M. Reed. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, pp. 175–178.)

H.F. BRIDGE CIRCUIT WITH NULL INDICATOR OF GREAT SENSITIVITY, FOR THE MEASUREMENT OF THE DIELECTRIC CONSTANT OF SLIGHTLY CONDUCTING COLLOIDAL SOLUTIONS.—T. Nanty and M. Valet. (*Comptes Rendus*, 4th April, 1934, Vol. 198, No. 14, p. 1308.)

AN IMPROVED VOLTAGE TUNING RESONANCE METHOD OF MEASURING THE DIELECTRIC CONSTANTS OF ELECTROLYTES.—Malone, Ferguson and Case. (*Physik. Ber.*, 15th March, 1934, Vol. 15, No. 6, pp. 432–433.)

THE MEASUREMENT OF SMALL RESISTANCES WITH THE WHEATSTONE BRIDGE.—K. H. Bohnenstengel. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 91–93.)

A METHOD OF ADJUSTING THE TEMPERATURE COEFFICIENT AND RESISTANCE OF LOW-VALUED RESISTANCE STANDARDS.—F. Wenner and J. L. Thomas. (*Bur. of Stds. Journ. of Res.*, February, 1934, Vol. 12, No. 2, pp. 147–154.)

THE CHARACTERISATION AND MEASUREMENT OF THE DAMPING OF OSCILLATORY CIRCUITS [Mechanical and Electrical: the "Damping Angle"].—Späth. (*See* under "Properties of Circuits.")

THE MEASUREMENT OF SPECIFIC RESISTANCE BY EDDY CURRENT SHIELDING [using Inductance Change produced by introducing Conducting Material into Field of Solenoid].—W. B. Kouwenhoven and G. P. Daiger. (*Review Scient. Instr.*, February, 1934, Vol. 5, No. 2, pp. 94–101.)

SHORT-WAVE AND ULTRA-SHORT-WAVE FIELD-STRENGTH MEASURING EQUIPMENTS.—Heinrich-Hertz Society. (*See* abstract under "Miscellaneous," section 1.)

THE RECORDING OF RESONANCE CURVES [of Receivers] BY THE CATHODE-RAY OSCILLOGRAPH.—Schadow. (*See* under "Reception.")

RADIO TESTING APPARATUS.—E. H. W. Banner. (*Elec. Review*, 29th Dec. 1933, Vol. 113, No. 2927, pp. 909–910.)

SU ALCUNE PROPRIETA' E POSSIBILITA' DI UN CIRCUITO A TRIODI (Some Properties and Possibilities of a Triode Circuit [Two Similar Triodes in Opposition as a Wattmeter Circuit]).—F. Neri. (*L'Elettrotec.*, 25th Jan. 1934, Vol. 21, No. 3, pp. 58–62.)

[Ultra-] HIGH-FREQUENCY MEASUREMENTS ON AN ELECTRON OSCILLATOR [by attaching a Special Lecher Wire Pair and observing Sag of One Wire due to Heat produced].—S. J. Borgars. (*Wireless Engineer*, March, 1934, Vol. 11 No. 126, pp. 134–136.)

THE VALVE VOLTMETER WITH ANODE-BEND RECTIFICATION.—A. Allerding. (*Zeitschr. f. Fernmeldetech.*, No. 3, Vol. 15, 1934, pp. 39–44.) Following on the general treatment of valve voltmeters referred to in April Abstracts, p. 217, l-h column.

A NEW SENSITIVE TWO-VALVE ELECTROMETER.—E. Hasché. (*Ann. der Physik*, 1934, Series 5, Vol. 19, No. 5, pp. 484–488.)

EIN HANDLICHES ELEKTROSTATISCHES VOLTMETER (A Small Electrostatic Voltmeter [with practically Linear Scale: Range up to 160 Volts: Capacity only about 11 cms: Tests at High Frequencies—Wavelengths down to 26 m]).—A. Palm. (*Zeitschr. f. tech. Phys.*, No. 3, Vol. 15, 1934, pp. 117–119.)

COPPER OXIDE RECTIFIERS IN AMMETERS AND VOLTMETERS [and the Errors liable to Arise].—E. Hughes. (*Electrician*, 9th March, 1934, Vol. 112, No. 2910, pp. 339–340.) Summary of I.E.E. paper.

DIRECT-READING MODULATION METER WITH CROSSED-COIL INSTRUMENT.—C. Lorenz Company. (German Pat. 585 989, pub. 14.10.1933: *Hochf:tech. u. Elek:akus.*, February, 1934, Vol. 43, No. 2, p. 70.)

NOTE ON THE RESONANCE RADIOMETER [and Its Brownian Unsteadiness: Working Sensitivity Several Times Greater than that of Steady Deflection Galvanometer].—J. D. Hardy: Pfund. (*Review Scient. Instr.*, March, 1934, Vol. 5, No. 3, pp. 120–124.) For Pfund's original paper on resonance radiometry *see* 1929 Abstracts, p. 337.

THE GIORGI (M.K.S.Ω) SYSTEM OF UNITS.—(*Nature*, 21st April, 1934, Vol. 133, pp. 597–598.) On the system referred to in April Abstracts, p. 218, r-h column (two).

SUBSIDIARY APPARATUS AND MATERIALS

BEHANDLUNG VON ABSCHIRMUNGSAUFGABEN DURCH EINE NÄHERUNGSMETHODE (The Treatment of Screening Problems by an Approximate Method).—J. Hak. (*Hochf:tech. u. Elek:akus.*, March, 1934, Vol. 43, No. 3, pp. 76–80.)

The exact solution of the screening problem by integration of Maxwell's equations is only possible in certain cases, such as for a thin, infinitely long cylinder, etc. Unless such a simplification is allowable, the solution meets with serious difficulties. A graphical integration is only possible if there is only one variable, either the conductivity or the frequency being taken as infinite. On the other hand, the approximate method based on the subdivision of the screen into a number of parts assumes no simplification of field or of screen; its error is dependent only on the subdivision, and the series given by increasing fineness of division are found to converge quickly, so that in practice there is no need to carry the subdivision too far. It is, moreover, sufficient to calculate once and for all certain numerical coefficients for a given shape of screen, and to tabulate these, in order to simplify the calculation for any form of coil. The present paper limits itself to results obtained for cylindrical screens; the treatment of finite plates and closed containers is reserved for a later paper.

THE EFFECT OF SCREENING CANS ON THE EFFECTIVE INDUCTANCE AND RESISTANCE OF COILS [with Simple Formulae for Calculation of Essential Characteristics].—G. W. O. H. (*Wireless Engineer*, March, 1934, Vol. 11, No. 126, pp. 115–117.) Editorial based on Kaden's work (1933 Abstracts, pp. 576–577).

THE DESIGN AND CONSTRUCTION OF LOW-LOSS COILS FOR RECEIVERS OF HIGH AMPLIFICATION AND SENSITIVITY.—F. G. Saic. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 113–116.)

ELECTRIC WAVE FILTERS FOR HIGH FREQUENCIES.—Frederick. (*See* under "Properties of Circuits.")

ON THE DIELECTRIC OF ELECTROLYTIC CONDENSERS.—O. Jauch, R. Bauder and M. Bentele. (*Zeitschr. f. tech. Phys.*, No. 4, Vol. 15, 1934, pp. 136–141.)

Authors' summary:—According to an earlier theory of Güntherschulze the dielectric in electrolytic condensers consists of a porous oxide layer in whose pores gas is adsorbed. It is shown by experiment that it is not a case of adsorption of the gas but of [electro-osmotic] deposition. It is also shown that two gas layers must exist in the oxide layer, of which only one [the "fine porous" layer] endows the layer with the power to exert a barrier action. On this theory a schematic picture of the dielectric is developed and the correctness of its principles established by a series of experiments.

CONDENSERS FOR BROADCAST RECEIVERS [Improvements in: Electrolytic, Variable, Trimmer and Padder].—(*Rad. Engineering*, March, 1934, Vol. 14, No. 3, pp. 8–9.)

HIGH-FREQUENCY LOSSES IN VARIABLE CONDENSERS [and a Comparison of Various Modern Insulating Materials: the Need for keeping High-Loss Materials away from Neighbourhood of Condenser].—L. Rohde and H. Schwarz. (*Funktech. Monatshefte*, March, 1934, No. 3, pp. 99–102.)

THE REQUIREMENTS OF SOME GLASSES USED IN THE ELECTRICAL INDUSTRIES [for Valves, Discharge Tubes, etc.].—E. Seddon. (*Glass Review*, Sheffield, April, 1934, Vol. 10, No. 4, pp. 56–61.) Part of a series.

TEMPERATURE EXPANSION OF PURE BAKELITE [Tendency to produce Internal Tension].—U. Retzow. (*Physik. Zeitschr.*, 1st April, 1934, Vol. 35, No. 7, p. 310.)

CONDUCTIVITY/TEMPERATURE CURVES OF PARAFFIN WAX [showing Temporary Decrease and Hysteresis Effect].—W. Jackson. (*Nature*, 28th April, 1934, Vol. 133, pp. 647–648.)

SYNTHETIC RESINS IN THE ELECTRICAL INDUSTRY [Insulating Materials].—N. V. Narayanaswami. (*Electrotechnics*, Bangalore, March, 1934, No. 7, pp. 54–58.)

NEW INSULATING MATERIALS WITH TITANIUM-OXIDE BASE: "CONDENSA" AND "KERAFAR": CORRECTION.—Schwandt.

In the paper dealt with in May Abstracts, p. 282, l-h column, the dielectric losses are given as tan $\delta = 8 - 18 \times 10^4$. In this value, which is quoted in the abstract, 10^4 should presumably read 10^{-4}.

THE SHOT EFFECT AND ELECTRICAL BREAKDOWN IN INSULATORS [Shot Effect caused by Electron Avalanches increasing in Size with the Field until Material is Ruptured].—F. E. Haworth and R. M. Bozorth. (*Physics*, January, 1934, Vol. 5, No. 1, pp. 15–19.) *See* also 1932 Abstracts, p. 476, r-h column.

ON THE POTENTIAL DISTRIBUTION IN INSULATING MATERIALS FOR A.C. POTENTIALS.—P. Böning. (*Physik. Ber.*, 15th Feb. 1934, Vol. 15, No. 4, p. 268.)

ELECTRODE SYSTEMS FOR DIELECTRIC LOSS MEASUREMENTS [especially the Use of Tinfoil].—E. Bradshaw. (*Journ. Roy. Tech. Coll.*, Glasgow, January, 1934, Vol. 3, Part 2, pp. 299–306.)

THE DIPOLE THEORY AND ABSORPTION IN DIELECTRICS [Survey].—M. A. G. Rau. (*Electrotechnics*, Bangalore, March, 1934, No. 7, pp. 26–32.)

RÉSUMÉ OF RECENT WORK ON THE ELECTRICAL BREAKDOWN OF LIQUID DIELECTRICS.—B. S. Ramaswami. (*Electrotechnics*, Bangalore, March, 1934, No. 7, pp. 95–99.)

THE DIELECTRIC CONSTANT OF AQUEOUS ELECTROLYTES AT 30 CM WAVELENGTH.—H. Stips. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 3/4, pp. 197–209.)

DIELECTRIC MEASUREMENTS ON [Various Organic] DIPOLE LIQUIDS [Wavelength 2 000 m].—J. L. Snoek. (*Physik. Zeitschr.*, 1st March, 1934, Vol. 35, No. 5, p. 196.)

COMPARISON OF ISOPERMS AND COMPRESSED POWDER CORES [Higher Stability, Lower Hysteresis and Higher Permeability of the Former].—R. Goldschmidt. (*Zeitschr. f. tech. Phys.*, No. 3, Vol. 15, 1934, pp. 95–99.) In a paper on "The Requirements of Materials in Communication Engineering, with Special Regard to the Construction of Pupin Coils." *See* also below.

LOW HYSTERESIS AND STABLE MATERIALS FOR COMMUNICATION ENGINEERING (Isoperms).—O. Dahl and J. Pfaffenberger. (*Ibid.*, pp. 99–106.)

PERMEABILITY OF NICKEL AND IRON AT VERY SMALL WAVELENGTHS, $\lambda = 4$ TO 10 M.—J. Müller. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 3/4, pp. 143–160.)

IRON BIASED BY A.C. [Application to Current-Transformer Technique].—G. Stein. (*Electrician*, 23rd March, 1934, Vol. 112, No. 2912, pp. 391–393.)

THEORY AND EXPERIMENTAL INVESTIGATION OF THE A.C. MAGNETIC FIELD IN THE AIR GAP OF A SOLID IRON MAGNET.—F. Haberland. (*Archiv f. Elektrot.*, 5th April, 1934, Vol. 28, No. 4, pp. 234–246 and 246–257.)

THE PRODUCTION OF VERY HOMOGENEOUS MAGNETIC FIELDS BY CIRCULAR CURRENTS [in Two Pairs of Coils; Numerical Data and Dimensions].—W. Braunbek. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 5/6, pp. 399–402.) For a paper by Bühl and Coeterier *see* 1933 Abstracts, p. 52, r-h column.

A METHOD OF PRODUCING UNIFORM MAGNETIC FIELDS [using Combinations of Two Long Straight Current-Carrying Conductors, or Their Equivalent].—I. I. Rabi. (*Review Scient. Instr.*, February, 1934, Vol. 5, No. 2, pp. 78–79.)

ON THE CHOICE OF GRID LEAK AT THE INPUT OF A VERY SENSITIVE AMPLIFIER [Higher-Frequency Components of Thermal Agitation Potentials suppressed by Grid Capacity: Application to Design of Valve Electrometers, etc.].—G. Stetter. (*Physik. Ber.*, 15th March, 1934, Vol. 15, No. 6, p. 430.)

ON THE CHOICE OF THE COUPLING ELEMENTS IN THE CONSTRUCTION OF AN AMPLIFIER WITH SHORT TIME CONSTANT.—G. Ortner and G. Stetter. (*Ibid.*, p. 430.)

THE LIGHT-BULB RESISTOR [with Curves and Table of Data for Various Ratings of Lamp, including "Auto" and "Flashlight."]—D. C. Redgrave. (*QST*, March, 1934, Vol. 18, No. 3, pp. 36–37.)

FIXED RESISTORS [and the Importance of Heat Coefficients, Voltage Coefficient and Humidity Effects].—(*Rad. Engineering*, March, 1934, Vol. 14, No. 3, pp. 5–6.)

VARIABLE RESISTORS [for Volume Controls and Tone Controls].—(*Ibid.*, pp. 6–7.)

THE ADSORPTION AND DIFFUSION PHENOMENA IN GASES AT PLACES OF CONTACT OF SOLID BODIES [Application to Production of Good Electrical Contacts].—E. Habann. (*Ann. der Physik*, 1934, Series 5, Vol. 19, No. 5, pp. 501–512.)

THE CONDUCTIVITY OF THIN FILMS OF COPPER SULPHIDE OBTAINED ON THE SURFACE OF CUPRIC SOLUTIONS.—H. Devaux and J. Cayrel. (*Comptes Rendus*, 9th April, 1934, Vol. 198, No. 15, pp. 1339–1342.)

THE PREPARATION OF SPUTTERED METAL FILMS.—E. O. Hulburt. (*Review Scient. Instr.*, February, 1934, Vol. 5, No. 2, pp. 85–88.)

THE TECHNIQUE OF SPUTTERING SENSITIVE THERMOCOUPLES [suitable for measuring the Adiabatic Heat in a Sound Field up to 5 000 c/s].—L. Harris and E. A. Johnson. (*Review Scient. Instr.*, April, 1934, Vol. 5, No. 4, pp. 153–158.)

EVAPORATION TECHNIQUE FOR HIGHLY REFRACTORY SUBSTANCES [Graphite, Molybdenum, Quartz, etc.].—H. M. O'Bryan. (*Review Scient. Instr.*, March, 1934, Vol. 5, No. 3, pp. 125–126.)

COLLOIDAL GRAPHITE IN ELECTRONICS FIELD.—R. Szymanowitz. (*See* under "Valves and Thermionics."

SOME PHYSICAL PROPERTIES OF PLATINUM-RHODIUM ALLOYS.—J. S. Acken. (*Bur. of Stds. Journ. of Res.*, February, 1934, Vol. 12, No. 2, pp. 249–257.)

CONTRIBUTION TO THE ELECTRON OPTICS OF BRAUN [Cathode-Ray] TUBES.—M. von Ardenne. (*Zeitschr. f. Physik*, 1934, Vol. 88, No. 3/4, pp. 251–259.)

This paper investigates the conditions for the production of small fluorescent spots, and therefore small magnifications, in high-vacua cathode-ray tubes. The connection between magnification and object/image distance is calculated and tested experimentally for electron-optical accelerating lenses of known types, and the influence of the Wehnelt cylinder on the magnification is investigated. Low-pressure gas concentration may also be used. A simple method for rendering visible the paths of the electron-optical rays, by the use of eccentric spots of oxide, is described. A system of lenses is used to investigate the process of formation of oxide cathodes.

"DIE KATHODENSTRAHLRÖHRE UND IHRE ANWENDUNG IN DER SCHWACHSTROMTECHNIK" (The Cathode-Ray Tube and Its Use in Communication Engineering [Book Review]).—M. von Ardenne. (*Wireless Engineer*, April, 1934, Vol. 11, No. 127, p. 198.)

THE CATHODE RAY OSCILLOGRAPH [Cossor Type: Subsidiary Apparatus].—F. H. Haynes. (*Wireless World*, 6th April, 1934, Vol. 34, pp. 238–240.)

A PRACTICAL CATHODE-RAY OSCILLOGRAPH FOR THE AMATEUR STATION.—L. C. Waller. (*QST*, March, 1934, Vol. 18, No. 3, pp. 13–18.)

THE USE OF NEON, WHOSE LIGHT IS OF LOW ACTINIC POWER, AS GAS FILLING FOR CATHODE-RAY TUBES.—Richter: A.E.G. (German Pat. 585 608, pub. 5.10.1933.)

THE GLOW-DISCHARGE LAMP AS AN OPTICAL INDICATOR—THE "INDICATOR" GASEOUS DISCHARGE LAMP [used also as an Oscillograph].—Pohle and Straehler. (*See* under "Reception.")

A MOTOR-DRIVEN MULTI-CONTACT COMMUTATOR WITH MANY APPLICATIONS [in Oscillography of Transient Processes, etc.].—H. Grünewald and W. Schröder. (*E.T.Z.*, 29th March, 1934, Vol. 55, No. 13, pp. 315–316.)

THE BLACKENING OF PHOTOGRAPHIC FILMS BY ELECTRONS AND ELECTRON-EXCITED FLUORESCENCE [Application to Electron Microscope—Investigation of Properties of Various Types of Film].—B. von Borries and M. Knoll. (*Physik. Zeitschr.*, 1st April, 1934, Vol. 35, No. 7, pp. 279–289.)

THE EFFECT, ON THE LATENT IMAGE, OF POST-HEATING AND OF MELTING THE GELATIN.—A. J. Reardon and H. P. Griggs. (*Journ. Opt. Soc. Am.*, March, 1934, Vol. 24, No. 3, pp. 85–90.)

A GAS X-RAY TUBE [of New Design: made in One Piece out of a Steel Rod].—G. Hägg. (*Review Scient. Instr.*, March, 1934, Vol. 5, No. 3, pp. 117–118.)

AN OIL MANOMETER FOR MODERATELY LOW PRESSURES [of the order of 5–0.01 mm of Mercury].—K. Hickman. (*Review Scient. Instr.*, April, 1934, Vol. 5, No. 4, pp. 161–164.)

THE THYRATRON AS A COUNTER OF ALPHA PARTICLES.—H. Teichmann. (*Physik. Zeitschr.*, 1st April, 1934, Vol. 35, No. 7, pp. 299–301.)

A NEW TYPE OF THYRATRON RELAY [Combination with Phanotron (2-Element Rectifier) gives Continuous, instead of Intermittent, Load Current: New Thyratron with Auxiliary Anode performs the Double Function: Good Results with Photocell].—G. Babat. (*Proc. Inst. Rad. Eng.*, March, 1934, Vol. 22, No. 3, pp. 314–323.)

NOTES ON MERCURY-ARC RECTIFIERS FITTED WITH CONTROL GRIDS [including Methods of Ignition Timing].—J. K. Catterson-Smith. (*Electrotechnics*, Bangalore, March, 1934, No. 7, pp. 89–91.)

THE PHYSICAL FOUNDATIONS OF THE DISCHARGES IN RECTIFIERS AND THEIR CONTROL BY GRIDS.—M. Steenbeck. (*Physik. Ber.*, 1st Feb. 1934, Vol. 15, No. 3, p. 222.)

DISCUSSIONS ON "AN EXPERIMENTAL IGNITRON RECTIFIER."—Ludwig, Maxfield and Toepfer. (*Elec. Engineering*, March and April, 1934, Vol. 53, Nos. 3 and 4, pp. 488–489 and 602–603.) *See* April Abstracts, p. 220, r-h column.

A VACUUM-TUBE CONTROLLED RECTIFIER [Hot-Cathode Mercury-Vapour Rectifier Equipment controlled by Saturable Reactors governed by Valves: to deliver Voltages between 50 and 5 000 Volts constant within 1%: primarily for Transmitting-Valve Testing].—C. B. Foos. (*Elec. Engineering*, April, 1934, Vol. 53, No. 4, pp. 568–570.)

DISCUSSIONS ON "THE EFFECTS OF RECTIFIERS ON SYSTEM WAVE SHAPE."—P. W. Blye and H. E. Kent. (*Elec. Engineering*, March and April, 1934, Vol. 53, Nos. 3 and 4, pp. 483–484 and 608–610). *See* March Abstracts, p. 163, r-h column.

BROADCAST INTERFERENCE FROM 6-PHASE MERCURY-VAPOUR RECTIFIERS FOR LIGHTING NETWORKS, WITH METHODS OF PREVENTION.—E. T. Glas. (*Teknisk Tidskrift*, 7th April, 1934, Vol. 64, No. 14, Supp. pp. 55–59.)

MERCURY-ARC POWER RECTIFIERS FOR WIRELESS STATIONS.—K. Kotschubey. (*Wireless Engineer*, March, 1934, Vol. 11, No. 126, pp. 130–133.)

FREQUENCY LOWERING BY CURRENT RECTIFIER WITH CAPACITY LOADING.—J. Kluge. (*Physik. Zeitschr.*, 1st April, 1934, Vol. 35, No. 7, pp. 275–278.)

By proper choice of the ignition phase and time constant of the resistance-capacity loading, a current rectifier connected to an a.c. supply can be used for reduction of the a.c. frequency. The principles underlying the action are discussed and illustrated by oscillograms.

"ELEKTRISCHE GASENTLADUNGEN, IHRE PHYSIK UND TECHNIK" (Electrical Discharges in Gases: Their Physics and Technique [Book Review]).—Engel and Steenbeck. (*Electronics*, March, 1934, p. 91.)

THE BARRIER LAYER IN LEAD SULPHIDE [and the Necessity of an Adsorbed Layer].—F. Heineck. (*See* May Abstracts, p. 276.)

A GAS THERMOSTAT [250 cc Bulb maintains Oven Temperature within less than 0.1°C of Desired Temperature].—A. J. Bailey. (*Science*, 23rd March, 1934, Vol. 79, No. 2047, p. 277.)

SOME NOTES ON THE IGNITION COIL.—A. W. M. Coombs. (*Journ. Roy. Tech. Coll.*, Glasgow, January, 1934, Vol. 3, Part 2, pp. 307–323.)

A DEVICE FOR AUTOMATICALLY PLOTTING CHANGES IN RATE OF AN INTERRUPTED SIGNAL [in Experimental Medicine].—R. Gesell. (*Science*, 23rd March, 1934, Vol. 79, No. 2047, pp. 275–276.)

A CIRCUIT DOUBLER FOR USE WITH A DOTTING RECORDER.—H. E. Beckett and H. Sheard. (*Journ. Scient. Instr.*, April, 1934, Vol. 11, No. 4, pp. 111–113.)

SOME APPLICATIONS OF THE MECHANICALLY CONTROLLED AIR-JET BOLOMETER [for driving Ink-Writers (replacing Valve Amplifiers): Direct Measurement of Small Currents: Recording both Quickly and Slowly Changing Processes: Power Relay: Recording Small Mechanical Movements: etc.].—H. Sell. (*Zeitschr. f. tech. Phys.*, Nos. 3 and 4, Vol. 15, 1934, pp. 112–117 and 129–135). *See* 1932 Abstracts, p. 535, for the earlier work on this device.

AN ELECTRONIC VOLTAGE RELAY [Contact-Making Voltmeter Circuit, Bridge Connection, Mains Driven: Sensitivities down to 0.25 Volt].—J. W. Graff. (*Electronics*, March, 1934, pp. 80-81.)

ELECTRONIC VOLTAGE CONTROL OF D.C. GENERATORS [Photocell behind Indicating Voltmeter governs Grid Bias of Valve Bank carrying Field Current].—W. P. Koechel. (*Electronics*, March, 1934, p. 86.)

THE STROBORAMA EQUIPMENTS AND THEIR APPLICATIONS.—A. Seguin. (*Bull. de la Soc. franç. des Élec.*, April, 1934, Vol. 4, Series 5, No. 40, pp. 405–428.) For this type of stroboscopic equipment *see* 1929 Abstracts, p. 341, r-h column.

THE REPRODUCTION OF PENCIL-ON-PAPER DRAWINGS BY MECHANICAL MEANS [Hand-Inked Work dispensed with for Usual Type of Drawings].—T. C. M. Woodbury. (*Bell Lab. Record*, April, 1934, Vol. 12, No. 8, pp. 238–240.)

A NEW ELASTIC COUPLING [Rubber Spheres pressed between Two Concave Surfaces].—Dornig. (*L'Elettrotec.*, 5th Nov. 1933, Vol. 20, pp. 734–737.)

A SIMPLE VARIABLE-SPEED GEAR [Wooden Cones connected by Solid Rubber Ball].—J. de G. Hunter: Waldram and Sandford. (*Journ. Scient. Instr.*, April, 1934, Vol. 11, No. 4, p. 127.)

STATIONS, DESIGN AND OPERATION

WIRED WIRELESS: THE PRINCIPLES OF AUDIO-FREQUENCY WIRE BROADCASTING.—P. P. Eckersley. (*Electrician*, 13th April, 1934, Vol. 112, No. 2915, p. 503: *Elec. Review*, 13th April, 1934, Vol. 114, No. 2942, p. 524.) Summaries of an I.E.E. Paper.

WIRED BROADCASTING WITH HIGH- AND LOW-FREQUENCY DISTRIBUTION.—P. E. Klein. (*Elektrot. u. Masch:bau*, 1st April, 1934, Vol. 52, No. 13, pp. 151–152: summary only.)

INSTALLING A RADIO RELAY SYSTEM: LINE ERECTION AND SUBSCRIBER'S EQUIPMENT.—(*Elec. Review*, 19th Jan. 1934, Vol. 114, No. 2930, pp. 79–80.)

SOUTH AMERICA'S 33 kW STATION: THE STORY OF RADIO-EXCELSIOR [LR5, Buenos Ayres].—A. B. Dougall. (*World-Radio*, 23rd March, 1934, Vol. 18, No. 452, p. 411.)

THE BERLIN HIGH-POWER BROADCASTING STATION.—A. Semm. (*E.T.Z.*, 29th March, 1934, Vol. 55, No. 13, pp. 313–315.)

THE INTERNATIONAL RADIOTELEGRAPHIC AND TELEGRAPHIC CONFERENCES IN MADRID AND LUCERNE.—E. Picault. (*L'Onde Élec.*, January and February, 1934, Vol. 13, Nos. 145 and 146, pp. 5–17 and 81–95.)

THE NEW BROADCASTING LONG-DISTANCE CIRCUIT SYSTEM "VERST 34."—L. Fenyö and K. Bär. (*T.F.T.*, February, 1934, Vol. 23, No. 2, pp. 29–33.)

THE GERMAN SHORT-WAVE STATION [Zeesen].—H. Mögel. (*Telefunken-Zeit.*, March, 1934, Vol. 15, No. 66, pp. 32–45: *T.F.T.*, February, 1934, Vol. 23, No. 2, pp. 38–46.)

PRESENT-DAY REQUIREMENTS OF COMMERCIAL SHORT-WAVE PLANT: PART 2.—RECEIVING PLANT.—H. Mögel. (*Telefunken-Zeit.*, March, 1934, Vol. 15, No. 66, pp. 19–26.) Continuation of the paper referred to in April Abstracts, p. 223. To be continued.

MICRO-RAY TELEPHONY—INAUGURATION OF A SERVICE BETWEEN BRITISH AND FRENCH AIRPORTS.—(*Elec. Review*, 2nd Feb. 1934, Vol. 114, No. 2932, pp. 158–159.)

THE MICRO-WAVE SERVICE BETWEEN LYMPNE AND ST. INGLEVERT.—A. Clavier and L. C. Gallant. (*Rev. Gén. de l'Élec.*, 7th April, 1934, Vol. 35, No. 14, pp. 475–480). French version of the paper referred to in May Abstracts, p. 282.

THE PROBLEM OF DUPLEX TELEGRAPHY IN THE MERCANTILE MARINE WIRELESS SERVICE [including "Shadow" Effect: Acceptor *versus* Rejector Circuits: etc.].—M. Reed. (*Wireless Engineer*, March, 1934, Vol. 11, No. 126, pp. 122–128.)

SOME ASPECTS OF POLICE RADIO COMMUNICATION.—H. E. Thomas. (*Electronics*, March, 1934, pp. 74–76 and 90.)

GENERAL PHYSICAL ARTICLES

FOUNDATIONS OF THE NEW FIELD THEORY.—M. Born and L. Infeld. (*Proc. Roy. Soc.*, 29th March, 1934, Vol. 144, No. A 852, pp. 425–451.)

Continuation of work referred to in Abstracts, March, p. 167, and April, pp. 202 and 223.

BORN'S THEORY OF THE ELECTRON.—P. Jordan: Born. (*Naturwiss.*, 6th April, 1934, Vol. 22, No. 14, pp. 214–218.)

An account of the significance in general physical investigations of Born's recently published theory of the structure of the electron (April Abstracts, p. 223).

THE OPTICAL PROPERTIES OF METALS [Discussion of Modifications introduced by Quantum Theory into Drude's Formulae for Metallic Reflection: Comparison with Experimental Results].—N. F. Mott and C. Zener. (*Proc. Camb. Phil. Soc.*, 30th April, 1934, Vol. 30, Pt. 2, pp. 249–270.)

ELEMENTARY NOTIONS OF QUANTUM MECHANICS.—K. K. Darrow. (*Reviews of Modern Physics*, January, 1934, Vol. 6, No. 1, pp. 23–68.)

ON THE RECIPROCAL ACTION OF WAVES AND PARTICLES IN A CONSTANT FIELD.—E. Sevin. (*Comptes Rendus*, 4th April, 1934, Vol. 198, No. 14, pp. 1309–1311.)

Extension of the work referred to in February Abstracts, p. 109, r-h column, which showed that the stationary state of electromagnetic waves and material particles satisfied the Schrödinger equation, to the case where there is an electromagnetic field independent of time.

HOW THE LAWS OF ELECTRODYNAMICS MAY BE RECOVERED FROM CERTAIN SOLUTIONS OF THE ELECTRIC WAVE EQUATION.—R. Reulos. (*Comptes Rendus*, 19th March, 1934, Vol. 198, No. 12, pp. 1137–1139.) Further development of the work referred to in May Abstracts, p. 283, l-h column.

ELASTIC WAVE ANALOGIES TO THE MOTION OF ELECTRONS IN FORCE FIELDS.—R. B. Lindsay. (*Proc. Nat. Acad. Sci.*, March, 1934, Vol. 20, No. 3, pp. 177–179.)

CURRENT HISTORY OF THE POSITIVE ELECTRON [including Advance Information on Results by Joliot and Curie giving "First Chemical Proof of Artificial Transmutation"].—K. K. Darrow: Joliot and Curie. (*Review Scient. Instr.*, March, 1934, Vol. 5, No. 3, pp. 115–116.)

MISCELLANEOUS

THE RESEARCH WORK OF THE HEINRICH-HERTZ SOCIETY, 1932/1933. (*E.N.T.*, February, 1934, Vol. 11, No. 2, pp. 69–72.)

Apart from the topics discussed below, many published works already dealt with in these Abstracts are enumerated. (1) A method of field-strength measurement with frame aerial, for wavelengths of 15 to 80 m, is outlined, and an equipment for u.s.w. field-strength measurement, with dipole and toroidal coils, is mentioned. (2) The use of a screen-grid buffer stage in the 9-metre tourmalin-controlled transmitter for propagation research, to prevent retroactive effects on to the crystal, is referred to. The corresponding 2-metre transmitter is still being worked on, the neutralisation of the several stages which are necessary to step up the power from the tourmalin stage presenting some difficulties. A 60-cm transmitter of several watts' power, with directive aerial system, has been built. Brake-audion reception of these waves has been closely investigated, and a screened receiver protected from interference from motors, etc., has been made.

(3) The Niemegk observations on atmospherics have been continued and extended to short wavelengths. Preparations are being made to use a rotating earth inductor and cathode-ray oscillograph to follow the rapid magnetic disturbances and simultaneously to record the atmospheric disturbances. (4) In valve research, an examination of the "brake characteristics" [see Hollmann, April Abstracts, p. 205, and back refs.] of various types of valve has been begun. The brake-field valve is particularly suitable for the electrical determination of filament-temperature, since the exponential region of the current/potential characteristic is considerably wider than in a space-charge valve. For investigations of the brake characteristic a thyratron interruptor circuit is used for the heating circuit, to eliminate the influence of potential drop along the filament.

(5) Tests on reception of the German P.O. 7-m wave 90-line television transmissions on increased power are mentioned. The new power is not by any means too large: reception is frequently influenced by weather conditions, and where light sources of high power had to be modulated considerable amplification was necessary. "A receiving method already introduced in the preceding year, whereby a receiving audion is slightly detuned with regard to the incoming wave, so that an intermediate frequency in the broadcast band is formed, has been found very successful. With this method, 4 or 5 valves are sufficient. The combination of capillary light sources with the mirror screw then gave pictures of good brightness, of format about 15 × 20 cm or even larger, suitable for viewing in a largish room."

(6) In broadcast receiver investigation, distortion measuring procedure has been improved so that

"klirr" factors down to 1/100 000 can now be measured. For receiver testing, in addition to the construction of a screened signal generator giving accurately adjustable radio-frequency of a given modulation depth, a double wire-mesh Faraday cage has been built which is extremely satisfactory in cutting out extraneous disturbances. (7) An investigation of phase modulation in broadcast transmitters has been begun. It has been found that one of the chief sources is insufficient tuning within the modulating stage. Methods have been developed to demonstrate this fact and to improve the tuning.

(8) In connection with the search for arrangements to produce very constant but adjustable frequencies, the electrical "mitnahme" effect has been investigated and a graphical method found by which the occurrence of this phenomenon, and the action of external conditions, can be made clear. The relationships outside the mitnahme region are also shown. The mutual action of more than two oscillations can also be studied: here a new phenomenon appears, "side-band mitnahme," whose laws were also investigated. (9) Researches on Rochelle salt oscillators have confirmed the theoretical result that owing to the crystallographic properties of the material transverse oscillations (and in special cases torsional oscillations) are excited under the conditions which lead to longitudinal oscillations in quartz oscillators. But it was also found that the departure from the harmonic law in the excitation of transverse oscillation (not in that of torsional oscillation) was considerably greater than should result from the transverse contraction. This departure may perhaps be caused by the effect of longitudinal oscillations of about the same frequency. Bars cut at 45° to the a-axis, in the a-b plane, can be excited to give strong oscillations which must be considered, from their character and frequency, to be longitudinal; their frequency can be calculated according to the known formulae. This fact need not be thought to contradict the theory, since the latter does not assert that longitudinal oscillations cannot be produced. This type of oscillation may be very violent; during the tests the bars often fractured near their middle points, where the crystal is most deformed for longitudinal oscillations at the fundamental frequency and its odd harmonics. In all these tests the bars were held at their nodes of vibration, to avoid additional damping.

(10) In acoustical researches, an electrical equivalent to the human vocal organs has been constructed. A generator supplies electrical pulses representing in form and frequency the air pulses of the larynx; these pulses excite electrical circuits corresponding to the vibrating spaces of the vocal organs. "With this apparatus every vowel of a given person can be imitated, and the frequencies, decrements and intensities of the individual sound formants determined, as well as the effect of changes of the formant elements on the colour of the sounds."

THE NEW DEFINITION OF "*j*" [and Its Wide Field of Investigation].—C. Turnbull. (*Electrician*, 23rd March, 1934, Vol. 112, No. 2912, p. 401.) *See* also 1932 Abstracts, p. 113, l-h column.

ON THE APPLICATION OF LEAST SQUARES. II.—W. E. Deming. (*Phil. Mag.*, April, 1934, Series 7, Vol. 17, No. 114, pp. 804–829.) *See* 1931 Abstracts, p. 226, for the first part.

A RAPID METHOD FOR THE SUMMATION OF A TWO-DIMENSIONAL FOURIER SERIES.—C. A. Beevers and H. Lipson. (*Phil. Mag.*, April, 1934, Series 7, Vol. 17, No. 114, pp. 855–859.)

STRUCTURAL ANALYSIS BY ELECTRIC CIRCUIT ANALOGIES.—V. Bush. (*Journ. Franklin Inst.*, March, 1934, Vol. 217, No. 3, pp. 289–329.)

TCHEBYCHEFF POLYNOMIALS AND THEIR RELATION TO CIRCULAR FUNCTIONS, BESSEL FUNCTIONS AND LISSAJOUS FIGURES.—B. van der Pol and Th. J. Weijers. (*Physica*, December, 1933, Vol. 1, No. 1, pp. 78–96: in English.)

"POTENTIALFELDER DER ELEKTROTECHNIK" [Book Review].—F. Ollendorff. (*Hochf: tech. u. Elek:akus.*, February, 1934, Vol. 43, No. 2, p. 72.)

"FUNKTIONENTHEORIE UND IHRE ANWENDUNG IN DER TECHNIK" [Book Review].—R. Rothe, W. Schottky and others. (*Ibid.*, p. 72.)

THE PROBLEM IN STATISTICS OF TESTING SEVERAL VARIANCES.—M. S. Bartlett. (*Proc. Camb. Phil. Soc.*, 30th April, 1934, Vol. 30, Pt. 2, pp. 164–169.)

ON SMOOTHING AND DIFFERENTIATION OF TABLES [from Data containing Accidental Error].—H. Jeffreys. (*Proc. Camb. Phil. Soc.*, 30th April, 1934, Vol. 30, Pt. 2, pp. 134–138.)

ON THE EFFECTS OF ELECTROMAGNETIC INDUCTION BETWEEN POWER AND COMMUNICATION LINES [and Their Reduction].—J. Fallou. (*Bull. de la Soc. franç. des Élec.*, March, 1934, Vol. 4, Series 5, No. 39, pp. 229–248.)

NOTE ON THE MUTUAL IMPEDANCE BETWEEN POWER AND TELEPHONE LINES [Extension of Carson-Pollaczek Formulae to include the Case of a Stratified Earth].—H. J. Josephs. (*P.O. Elec. Eng. Journ.*, April, 1934, Vol. 27, Part I, pp. 61–62.)

THE EFFECT OF THE HIGH-FREQUENCY ELECTRICAL FIELD ON THE COMBUSTION VELOCITY OF GAS MIXTURES.—Malinowski and others. (*Physik. Zeitschr. der Sowietunion*, No. 2, Vol. 5, 1934, pp. 212–220.)

ON THE USE OF VALVES AND UNDAMPED RADIO-FREQUENCY OSCILLATIONS IN QUANTITATIVE SPECTRUM ANALYSIS.—G. Potapenko (*Physik. Ber.*, 15th Feb. 1934, Vol. 15, No. 4, p. 276.)

BEYOND URANIUM WITH THE MAGNETO-OPTIC METHOD OF ANALYSIS [Failure of Method].—J. Papish and A. C. Shuman: Allison. (*Science*, 30th March, 1934, Vol. 79, No. 2048, pp. 297–298.) *See* Abstracts, 1932, p. 660, l-h column, and 1931, p. 399, r-h column; and next two abstracts.

ON THE EXISTENCE OF TIME LAG IN THE FARADAY EFFECT [Discrepancies in the Theory of the Magneto-Optical Method of Analysis].—J. S. Webb and D. R. Morey: Allison. (*Phys. Review*, 1st Oct. 1933, Vol. 44, pp. 589–601.)

A MAGNETO-OPTIC METHOD OF DETERMINING THE VITAMIN CONTENT OF VARIOUS SUBSTANCES.—G. M. Wissink: Allison. (*Physics*, January, 1934, Vol. 5, No. 1, pp. 31–34.) For other papers on this method *see* two preceding abstracts.

PHOTOELECTRIC RECORDING MICROPHOTOMETER WITHOUT SLIT OR AMPLIFICATION.—C. Sannié. (*Comptes Rendus*, 19th March, 1934, Vol. 198, No. 12, pp. 1149–1151.)

PHOTOELECTRIC BURGLAR-ALARM SYSTEM.—F. von Meissner. (*L. M. Ericsson Review*, No. 1, 1934, pp. 26–30.)

INFRA-RED GUARD RAY EQUIPMENT.—Siemens and Halske. (*Electrician*, 6th April, 1934, Vol. 112, No. 2914, p. 471.)

CAPACITY EFFECTS: THEIR USE FOR THYRATRON TUBE CONTROL [for Counting Purposes, Lighting-Up of Shop Windows after Closing Hour on Approach of Passer-By, etc.].—F. de la C. Chard. (*Electrician*, 9th March, 1934, Vol. 112, No. 2910, p. 338.)

ULTRA-MICROMETRIC METHODS IN INDUSTRY (Paper Spinning, etc.) USING THE AIR JET BOLOMETER.—Sell. (*See* reference under "Subsidiary Apparatus and Materials.")

THE DETERMINATION OF THE MOISTURE CONTENT OF WOOD [including the Electrical Capacity (Ultra-Micrometric) Method].—J. S. Rankin. (*Journ. Roy. Tech. Coll.*, Glasgow, January, 1934, Vol. 3, Part 2, pp. 212–217.) For a neon-tube method *see* 1932 Abstracts, p. 241: for measurements on seeds, wheat, etc., 1932, p. 480, and 1933, p. 581: on paper, 1932, p. 242, and 1933, p. 232.

THE USE OF THE CATHODE-RAY OSCILLOGRAPH IN LOCATING FAULTS IN LINES AND CABLES.—Cremer-Chapé and J. Röhrig. (*E.T.Z.*, 22nd March, 1934, Vol. 55, No. 12, p. 307: summary only.)

INTERNATIONAL CONGRESS OF ELECTRO-RADIO-BIOLOGY TO BE HELD IN VENICE, SEPTEMBER, 1934. (*Electronics*, March, 1934, pp. 88–89: *Science*, 13th April, 1934, Vol. 79, No. 2050, pp. 334–335.)

"All subjects concerning oscillatory and corpuscular phenomena in relation to biology will be under review," including supersonics, penetrating radiation and its probable influence on organic matter and living organisms, long-distance action of metals, mitogenetic radiation, electric states of the atmosphere, and the influences of radiation on heredity.

THE USE OF SHORT AND ULTRA-SHORT WAVES IN MEDICINE [Survey].—W. Holzer. (*Elektrot. u. Maschinenbau*, 18th March, 1934, Vol. 52, No. 11, pp. 121–127.)

THE DIELECTRIC CONSTANT AND ABSORPTION OF SEVERAL ORGANIC FLUIDS AT 1.82 M [Ultra-Short Wavelengths].—W. T. Szymanowski. (*Physik. Ber.*, 1st March, 1934, Vol. 15, No. 5, pp. 345–346.)

[Ultra-Short-Wave] OSCILLATOR KILLS GRAIN WEEVILS IN FEW SECONDS.—I. E. Mouromtseff. (*Elec. World*, 18th Nov., 1933, Vol. 102, No. 21, p, 667.)

"The 'standing-wave oscillator' used [1933 Abstracts, pp. 98 and 98–99] is by far the most powerful generator of oscillations in the frequency band between 40 and 100 megacycles per second now known. At this frequency it is capable of furnishing about 20 kw of high-frequency power."

"SEEING MAGNETISM."—A. T. Bartlett. (*Electrician*, 16th March, 1934, Vol. 112, No. 2911, p. 373.) A letter confirming a phenomenon described by another correspondent in the issue of 2nd March of the same journal.

THE LIVING ORGANISM AS A RADIO AERIAL [Effects found even with Cold-Blooded Animals: Disappear on Death].—K. Moeckel. (*Zeitschr. f. Strahlentherapie*, No. 3, Vol. 48, 1933, p. 595: summary in *Funktech. Monatshefte*, March, 1934, No. 3, p. 110.)

THE IONISING ACTION OF FRESH VEGETABLE TISSUE PULP, AND THE MITOGENETIC RADIATION [Researches with Micro-Photo-Electroscope].—L. Petri. (*Physik. Ber.*, 15th Feb. 1934, Vol. 15, No. 4, p. 290.)

INTEGRATIVE MANUFACTURING ["Vertical" Control *versus* "Lateral" Control].—L. Mc Canne. (*Rad. Engineering*, March, 1934, Vol. 14, No. 3, pp. 10–13.)

RADIO STATISTICS AND MARKETS [in 1933].—(*Electronics*, March, 1934, pp. 66–69.)

WORKS AND RESEARCHES OF THE LABORATOIRE NATIONAL DE RADIOÉLECTRICITÉ IN 1933.—C. Gutton. (*Ann. des P.T.T.*, February, 1934, Vol. 23, No. 2, pp. 89–104.)

MORATORIUM ON SCIENCE WOULD BE FATAL TO RECOVERY [Discussion at Joint Meeting of American Institute of Physics and New York Electrical Society].—Compton, Millikan and Jewett. (*Elec. World*, 3rd March, 1934, Vol. 103, No. 9, pp. 324–326.)

SCIENCE MAKES JOBS [Research creates Employment, not Unemployment].—Roosevelt, Jewett and others. (*Electronics*, March, 1934, p. 77.) *See* also *Electrician*, 23rd March, 1934, Vol. 112, p. 390.

INVENTION IN RELATION TO NATIONAL WELFARE AND LEGISLATIVE CONTROL [Address to Television Society].—Ambrose Fleming. (*Television*, April, 1934, Vol. 7, No. 74, p. 178: summary only.)

INDUSTRIAL PHYSICS [Presidential Address].—P. D. Foote. (*Review Scient. Instr.*, February, 1934, Vol. 5, No. 2, pp. 57–66.)

THE BRITISH POLAR YEAR EXPEDITION TO FORT RAE, NORTH-WEST CANADA, 1932–33.—J. M. Stagg. (*Nature*, 7th April, 1934, Vol. 133, pp. 517–518.)

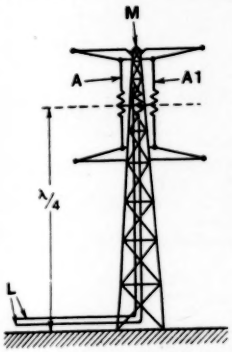
Some Recent Patents

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/-. each

BROADCASTING AERIALS

Convention date (Germany), 7th October, 1931.
No. 403376

To produce the strongest possible ground radiation, with a minimum space-wave component, one or more vertical dipoles *A*, *A1* are so proportioned and arranged that the effective centre of oscillation of each is not more than a half-wavelength above the ground. By the centre of oscillation is meant that point of the aerial which represents a current loop or voltage node. The system is energised by a pair of feed-lines *L* running up the centre of the supporting mast *M*. A series of such dipoles may be arranged one behind the other and at gradually increasing heights up to the limit mentioned.



No. 403376.

Patent issued to C. Lorenz Akt.

SHORT-WAVE GENERATORS

Convention date (Germany), 28th June, 1932.
No. 403437

In order to minimise the effect of the screening-grid in a four-electrode valve used for generating short waves, the "geometry" of the electrode-system is made such that the screening grid is situated at a potential node. The relative formulae are set out in the specification.

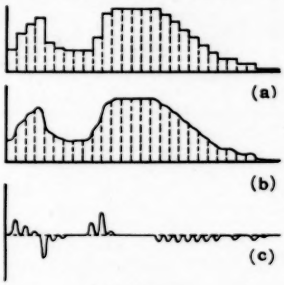
Patent issued to Telefunken Ges. Fur Drahtlose Telegraphie M.B.H.

TELEVISION SYSTEMS

Application date, 9th March, 1932. No. 403395

Television signals are radiated direct (*i.e.*, without utilising a carrier and side bands) on a wavelength of 1,000 metres, the transmission being of such a nature that the normal type of broadcast receiver does not respond to it. The object is to open the ether to simultaneous but non-interfering sound and picture programmes.

The picture is first focussed through a grating of thin glass plates which "integrates" each elementary area by repeated internal reflection. The resulting light "complex" is next passed through an "echelon" device, comprising a series of stepped lenses, which transform the original two-dimensional shape of the picture into a unilateral line or "stixograph," which is then projected on to a photo-electric cell by a vibrating mirror. The resulting current impulses have a frequency of the order of 100,000 cycles and an outline of the form shown in Fig. (*a*). This is converted into a curve of the form shown in Fig. (*b*) by the action of a lens having a "versed sine" characteristic, placed across the input slit of the photo-electric cell. Transformer coupling converts the second curve to the form shown in Fig. (*c*), which is made up of a succession of out-of-phase impulses, each being of insufficient duration to build up in an ordinary tuned receiver.



No. 403395.

The picture signals at the receiving end are converted back into the equivalent of Fig. (*b*), by a push-pull arrangement of amplifiers feeding a third or "cumulative" amplifier.

Patent issued to G. W. Walton.

COMBINED SOUND AND TELEVISION

Application date, 19th March, 1932. No. 403397

Speech currents are first converted into "visible" signals in the form of a "band" of spark discharges, which are spaced apart by distances corresponding to the different frequencies of the original sounds. The visible signals so produced are then combined with the "stixograph" of the picture to be televised, in the manner described in the preceding patent (403395). The conversion of sound into an equivalent light signal is effected by means of two rod electrodes in close proximity to a third electrode or coil, the whole being enclosed in an evacuated vessel. The coil carries a voltage just below the discharge point, whilst the rods are fed with sparking voltages derived from the microphone. Each spark occurs at that point along the length of the coil electrode at which the resulting discharge current flows through a circuit in resonance with the applied frequency. In other words the sparks are automatically spaced apart in accordance with the applied speech frequencies at each given moment.

Patent issued to G. W. Walton.

STABILISING FREQUENCY

Convention date (U.S.A.), 23rd April, 1932.
No. 403559

The frequency of a screened-grid oscillator is stabilised by a thermostatically-controlled tuning-fork which serves to back-couple driving-coils in the plate circuit to pick-up coils in the grid circuit. The screening grid is tapped to a potentiometer resistance shunted across the high-tension supply, the tapping point being such that the amplification-factor of the valve is maintained constant irrespective of fluctuations in the supply voltage.

Patent issued to Marconi's Wireless Telegraph Co., Ltd.

SHORT-WAVE ADAPTORS

Convention date (Germany), 17th June, 1931.
No. 403629

For the sake of cheapness and simplicity, a short-wave adaptor to be fitted to an existing mains-driven set is provided with a separate small transformer supplying its own cathode current, the anode voltage being tapped off from one of the loud-speaker terminals. The adaptor valve is designed to take only a small anode current so that the additional loading on the set is insignificant.

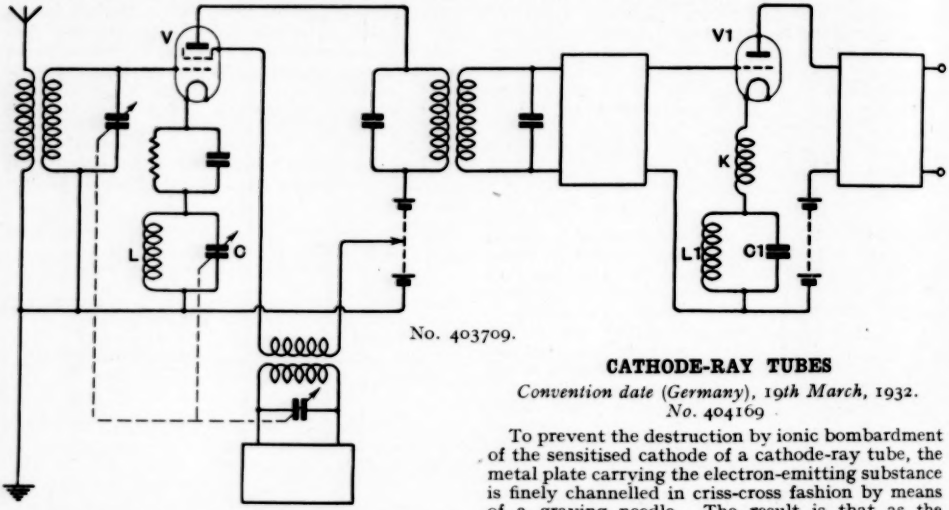
Patent issued to Telefunken Ges. Fur Drahtlose Telegraphie M.B.H.

SUPERHETERODYNE RECEIVERS

Application date, 26th May, 1932. No. 403709

To eliminate undesired signals, particularly second-channel interference in a superhet, a rejector circuit C, L variably tuned to the image frequency is inserted in the common plate and grid circuit of the first detector valve V, as shown. The arrangement is stated to increase the effective blocking action of the circuit C, L. In addition a second circuit L_1, C_1, fixedly tuned to the second harmonic of the intermediate frequency, is inserted in the plate-grid circuit of the second detector V_1. It is also in series with a coil K, designed to choke out the third and higher harmonics of the intermediate frequency.

Patent issued to Electrical and Musical Industries, Ld., and P. W. Willans.



No. 403709.

CATHODE-RAY TUBES

Convention date (Germany), 19th March, 1932.
No. 404169

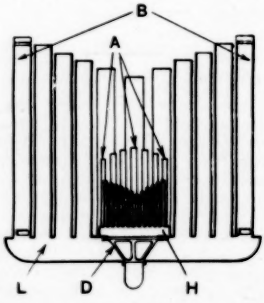
To prevent the destruction by ionic bombardment of the sensitised cathode of a cathode-ray tube, the metal plate carrying the electron-emitting substance is finely channelled in criss-cross fashion by means of a graving needle. The result is that as the cathode becomes overheated, the sensitised material gathers more and more into the grooves, and by adhering there escapes atomisation.

Patent issued to International General Electric Co., Inc.

LOUD SPEAKERS

Convention date (France), 3rd June, 1932.
No. 403843

A loud speaker is fitted with a series of resonator tubes adapted to be impulsed by the diaphragm. The arrangement is such that the high-note resonators A are actuated by air-waves generated by the front surface of the diaphragm D in a chamber H, whilst the low-note resonators B are actuated by waves generated by the back surface of the diaphragm in a separate chamber L.



No. 403843.

Patent issued to A. d'Alton.

TUNING DEVICES

Application date, 4th July, 1932. No. 403740

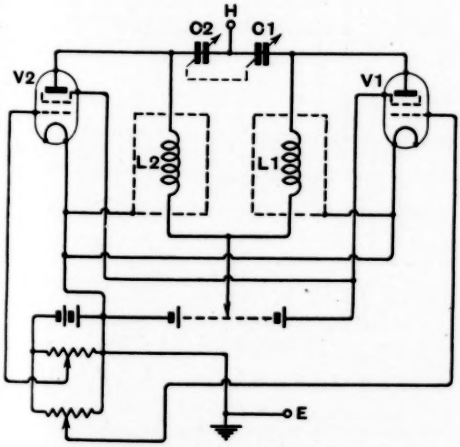
In a short-wave receiver, where tuning is naturally critical, the search for a given station is facilitated by superposing a periodic to-and-fro movement upon each progressive movement of the tuning dial. The periodic movement, which may be imparted by a pendulum device, is so arranged that each tuning point is maintained at a constant value for 60 per cent. of the time, plus a 20 per cent. reach in the forward direction, and a 20 per cent. reach in the backward direction. Instead of a pendulum arrangement, the required tuning "sweep" may be obtained by imposing a periodic variation on the voltage applied to the plate circuit of one of the valve amplifiers.

Patent issued to Marconi's Wireless Telegraph Co., Ltd.

AERIAL COUPLINGS

Convention date (Germany), 16th July, 1932. No. 404225

Relates to distributing systems, wherein a single aerial is used to supply a number of different receivers through a common transmission line. In order to secure a more uniform amplification-ratio over the whole frequency range, the aerial is coupled to two or more H.F. amplifiers arranged in parallel. The input circuit to each amplifier includes a filter circuit which allows the passage only of a pre-determined band of frequencies, one band being complementary to the other. The output transformers are separately matched to



No. 404349.—Fig. 1.

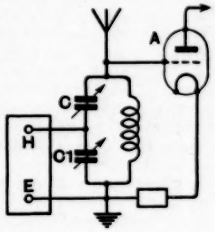
the impedance of the transmission line for the particular frequency-band handled by each amplifier.

Patent issued to N. V. Philips Gloeilampenfabrieken.

SELECTIVE RECEIVERS

Application dates, 14th July and 24th October, 1932. No. 404349

A selective circuit of the band-pass type is designed to reduce the normal level of the resonance curve beyond the band of frequencies to be accepted, which, under certain circumstances, may result in interference from a station on a relatively remote wavelength from that to which the circuits are tuned. Two circuits $C1$, $L1$, and $C2$, $L2$, Fig. 1, are slightly "staggered" in frequency, so that each gives an asymmetric response, though the two together produce a substantially symmetrical resonance curve free from any external "rising" response. Negative resistance is applied by the screened-grid valves $V2$, $V1$ to the screened coils $L2$, $L1$. In Fig. 2, the circuit of Fig. 1 is applied at the terminals marked HE, across the midpoint of the two aerial condensers C, $C1$, and earth, the input to the first amplifier A of the receiver proper being taken from across both condensers as shown.



No. 404349.—Fig. 2.

Patent issued to Marconi's Wireless Telegraph Co., Ltd., and N. M. Rust.

PIEZO-ELECTRIC OSCILLATORS

Convention date (Germany), 28th April, 1932. No. 404185

A piezo-electric crystal when mounted between plane electrodes and used at very high frequencies is liable to be destroyed, owing to the setting-up of transverse and torsional stresses in addition to the main longitudinal vibration. This is due, at least in part, to the fact that flat electrodes serve to concentrate the applied field centrally instead of allowing a uniform distribution and penetration of the crystal surface. According to the invention the difficulty is overcome by making that face of the electrode which is next to the crystal concave, instead of plane.

Patent issue to Carl Zeiss.

ULTRA-SHORT-WAVE RECEIVERS

Convention date (Germany), 2nd June, 1932. No. 404207

When receiving short-wave signals on a valve amplifier of the Barkhausen-Kurz type, there are certain conditions—near the oscillating point—when no anode current flows, so that it becomes impossible to couple the valve to a further stage of amplification in the ordinary way. The valve does however radiate directly from the grid at the received frequency, and this energy is picked up by a small dipole aerial located near to the first valve and directly connected to the grid of the second amplifier, thus enabling cascade amplification to be carried out.

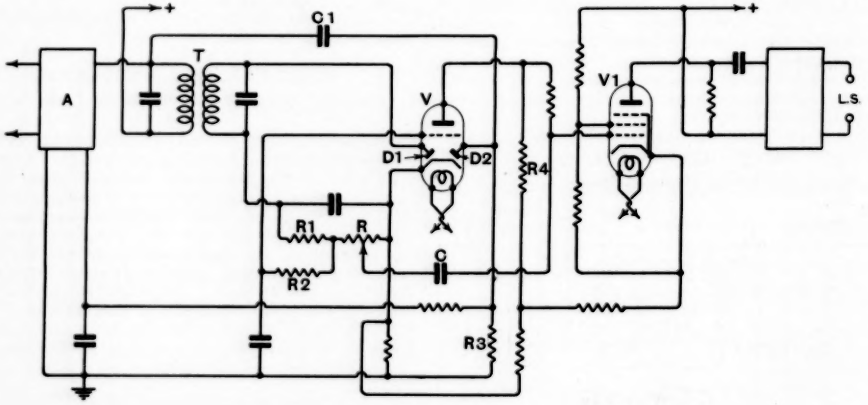
Patent issued to Naamlooze Vennootschap Machinerieen-en Apparaten Fabrieken.

AUTOMATIC GAIN CONTROL

Convention date (U.S.A.), 25th August, 1932.
No. 404583

A double-diode-triode valve V arranged for delayed AVC with the suppression of inter-channel "noise" is characterised by an arrangement for increasing selectivity. The rectified voltages developed in the resistances R, R_1 across the diode D_1 and cathode are fed, so far as the audio-frequencies are concerned, through condenser C to the grid of the L.F. pentode V_1, whilst the DC voltage goes back through resistance R_2 to the control grid of the valve V. The diode D_1 is fed direct from the secondary of the transformer T, whilst the diode D_2 is fed through condenser C_1 from the primary of the same transformer. The control voltage for the intermediate frequency amplifier A is developed across the resistance R_3 in the circuit of the diode D_2, and as it is taken from the primary instead of the secondary winding of the transformer T, it passes through one tuned circuit less than the signal voltage applied to one diode D_1. The consequence is that the resonance curve of the signal is sharper than that of the AVC voltage, giving an apparent gain in selectivity. When the receiver is off-tune, the negative bias in the grid of V is reduced, owing to the absence of the carrier energy, and the plate current through R_4 puts a prohibitive bias on the amplifier V_1 to open-circuit the loud speaker.

Patent issued to Marconi's Wireless Telegraph Co. Ltd.



No. 404583.

DIRECTION FINDING

Convention date (U.S.A.), 11th April, 1931.
No. 404659

In the absence of the usual D.F. beacon station, a navigator can take bearings from any broadcast transmission within range by means of a receiver which is prepared for this particular purpose by switching-in a local oscillator, and replacing the loud speaker by an ammeter or visual indicator. The amplitude of the local heterodyne is adjusted to reduce the effect of the signal side-bands relatively to that of the carrier wave, thereby allowing a clear-cut maximum or minimum deflection to be obtained on the visual indicator. The receiving frame is screened and provided with balancing condensers to eliminate the "open aerial" effect. A gauged system of switches allows the set to be rapidly changed over from ordinary broadcast to directive reception.

Patent issued to Bendix Aviation Corporation.

SHORT-WAVE DETECTORS

Application date, 22nd July, 1932. No. 404708

A valve in which the grid is positively biased with respect to the anode and cathode, so that the electron stream is set into oscillation, is used as a short-wave detector in the following manner. The incoming signals are applied across the anode and cathode, and the biasing voltage applied to the grid is critically adjusted to such a valve that a correspondence is created between the signal frequency and the natural "periodicity" of the electron-stream oscillation about the grid.

Patent issued to Marconi's Wireless Telegraph Co., Ltd., and E. W. B. Gill.

THERMIONIC VALVES

Application date, 19th July, 1932. No. 404672

A cylindrical anode is fitted with a series of lugs projecting towards the filament, or a flat-plate type of anode may be similarly fitted with projecting fins. The projections serve to reduce the electric field in the vicinity of the anode, thereby preventing secondary emission even if the anode voltage swings below that of the adjacent screening-grid or other electrode.

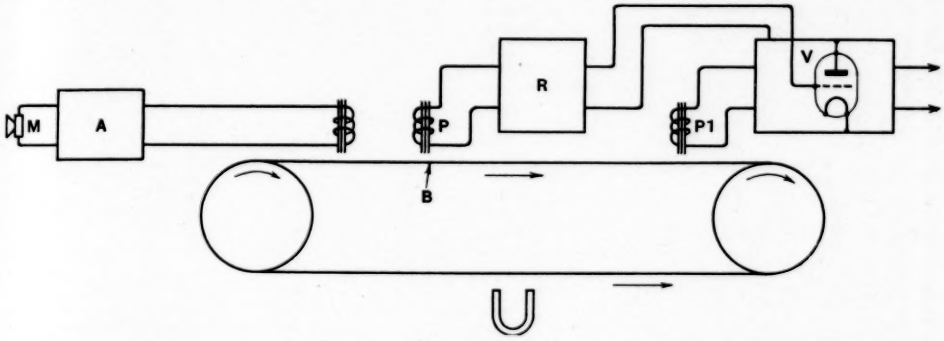
Patent issued to Standard Telephones and Cables, Ltd.

MONITORING SYSTEMS

Application date, 22nd July, 1932. No. 404706

Currents from a microphone *M* are passed through an amplifier *A* designed to give an output larger than could normally be handled without distortion by the subsequent amplifier or modulator. The output is then magnetically recorded on a telegraphone band *B*, which is provided with two pick-up devices *P*, *P*1, one being in advance of the other. The voltage from the first pick-up *P* is rectified at *R*, and is amplified if necessary and then used solely to regulate the gain of the amplifier *V*. The arrangement permits of a more economical use of the amplifiers than is otherwise possible.

Patent issued to Marconi's Wireless Telegraph Co., Ltd., and S. Aisenstein.



No. 404706.

MODULATING SYSTEMS

Convention date (Germany), 16th July, 1931. No. 404656

Modulation is effected by connecting a high-frequency generator to a low-frequency source through a common coupling-element, such as silicon carbide, graphite, cobalt oxide, or copper oxide, the resistance of which varies instantaneously with the value of the applied voltage.

Patent issued to International General Electric Co.

LOUD SPEAKERS

Application date, 14th July, 1932. No. 404937

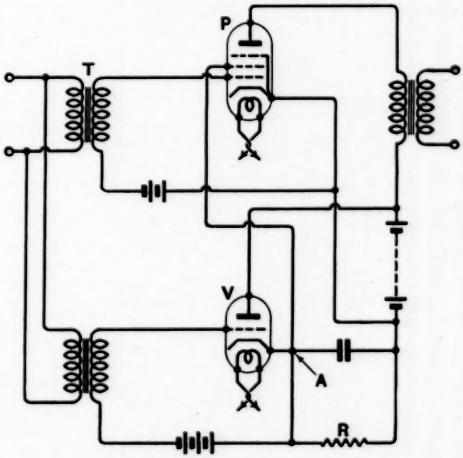
The tone of a loud speaker is controlled and modified by arranging a series of "louvres" or baffle-plates in front of the diaphragm. Each louvre is mounted on a separate spindle fitted with its own control knob, so that certain of them open inwards, whilst others can be swung outwards according to the effect desired.

Patent issued to W. R. Millar.

PENTODE CIRCUITS

Application date, 29th June, 1932. No. 405004

Advantage is taken of the fact that voltages applied to the auxiliary grid of a pentode amplifier will, without substantially changing the anode—cathode impedance, alter the static characteristic curve, so that a cut-off effect is obtained. In the Figure the valve *V* serves to control the output from the pentode *P* in this manner. The auxiliary grid of the pentode is connected at *A* to the filament of valve *V*, which is normally biased to pass no current. As the point *A* is at the negative end of the H.T. supply, the pentode *P* is then non-conductive, but the application of a signal voltage at *T* produces a voltage across the resistance *R*, which increases the positive potential on the auxiliary grid of the pentode. This in turn removes the cut-off effect, and enables the pentode to pass the applied signals in the ordinary way.



No. 405004.

The same principle may be applied to the control of modulating and transmission circuits.

Patent issued to Igranic Electric Co., Ltd., and L. H. Paddle.

TELEVISION RECEIVERS

Application date, 20th July, 1932. No. 405006

To increase optical efficiency, the lamp used for scanning contains inside the bulb an apertured stop mounted at a distance from the source of light equal to the diameter of the projected spot of light. The rays pass first through a pair of lenses, each having a diameter equal to its focal length, the first lens being mounted its focal length away from the apertured spot. They then pass through Nicols and a Kerr cell to a mirror drum and viewing screen. The mirror drum is of small dimensions—a diameter of two inches being sufficient to give 30-line scanning—and is mounted in the same casing as a phonic motor.

Patent issued to Pye Radio and P. C. Goldmark.

"VISUAL" SIGNALLING SYSTEMS

Application date, 28th July, 1932. No. 405018

Relates to a method of transmitting wind and weather reports and similar information for the benefit of navigators, either at sea or in the air, in such form that the purport of the message is directly conveyed in visible form. The radiated carrier-wave is modulated by one or more tone frequencies which, at the receiving end, are applied to control a cathode-ray tube, so as to direct the ray to particular markings on an associated indicator dial. The dial, for instance, may be marked to show different compass directions for the prevailing wind and with suitable graduations to indicate its strength. Similarly, conditions of visibility, height of clouds and local temperature may be provided for. The depth of each tone modulation is an independent factor used to control the cathode-ray indicator.

Patent issued to Marconi's Wireless Telegraph Co., Ltd. and A. A. Linsell.

INTERFERENCE PREVENTERS

Convention date (Germany), 7th March, 1932. No. 405113

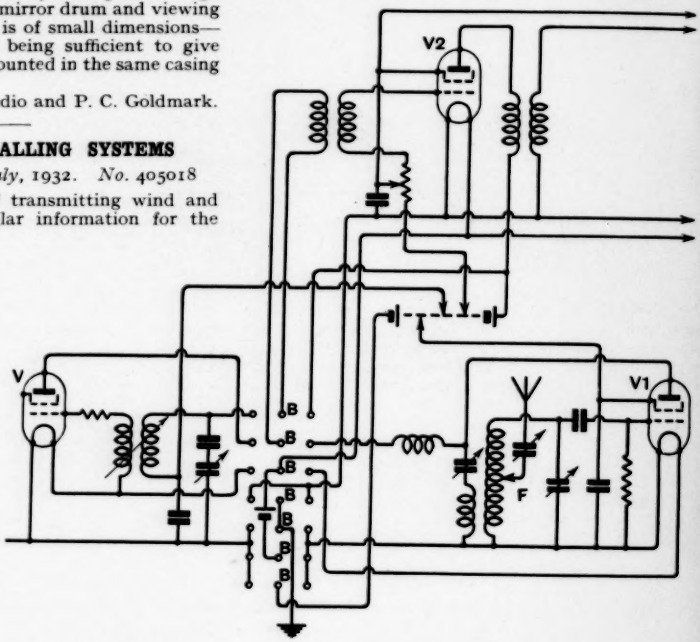
To prevent "static" radiation from the motors of domestic labour-saving devices, both the brushes and the field-windings are shunted by condensers as usual, but in order to prevent the risk of shock which exists when the condenser circuit is earthed to the casing of the apparatus, the shunt condensers in question are housed in a separate metal box located inside the main casing, where there is no danger of the operator making accidental contact with it.

Patent issued to Electrolux, Ltd.

SUPERHET SETS

Application date, 12th May, 1932. No. 405049

In order to extend the tuning range say from 15 to 2,500 metres, without the necessity of changing coils, one frequency-changing valve *V* is used for the long and medium waves, and a separate frequency-changer *V1* for the short waves, one or other of these valves being coupled to the common intermediate frequency amplifier *V2*, according as the switch marked *B* is thrown to the right or left. A band-pass input circuit (not shown) feeds the valve *V*, that for the valve *V1* being shown at *F*. The arrangement allows ganged tuning control to be used on either setting of the wave-change switch *B*.



No. 405049.

Patent issued to J. G. S. Nott and W. J. C. Nott.

Application date, 9th June, 1932. No. 405175

A local oscillator of the tuned-anode type is used to inject into the grid circuit of the frequency-changer, and a shunt condenser is inserted at a point between the anode and grid coils to earth. This is stated to reduce the transfer of harmonic frequencies and to increase accuracy in "tracking" the two circuits. Also since the reaction of the condenser falls with increasing frequency, whilst the oscillator output tends to do the reverse, the injection voltage is held at a substantially constant level throughout the whole tuning range.

Patent issued to Cromwell (Southampton), Ltd., and H. A. Brooke.